DOCUMENT RESUME

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ABSTRACT

This course syllabus is for five 18-week courses in the Metal Fabrication Program at Northeast Wisconsin Technical College (NWTC): (1) metal fabrication I; (2) blueprint reading and sketching; (3) applied layout tech I; (4) metal fabrication II; and (5) applied layout tech II. Each syllabus contains some or all of the following: (1) course information--summary statement, rationale for course, course objectives, classroom policy, student texts, references, visual aids, and special equipment and supplies; (2) weekly syllabus--lessons, reading assignments, and laboratory assignments; (3) course outline and request for course approval; and (4) NWTC instructional plan terminal competencies, each containing learning activities/resources and evaluation methods for unit specific objectives. (NLA)

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METAL FABRICATION PROGRAM CURRICULUM DEVELOPMENT

Northeast Wisconsin Technical College
Green Bay, WI

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METAL FABRICATION I

W191CD13

COURSE SYLLABUS

METAL FABRICATION I - COURSE NO. 457-311

I. SUMMARY STATEMENT

Metal Fabrication
Metal Fabrication 1
457-311- 8 Credit Hours

Office Location:
Telephone Number: (414) 743-2207
Advising time:

This course includes theory and hands on shop training in the safe use of all metal fabrication processing equipment including, pneumatic equipment, gas buring, electric arc cutting, plasma arc cutting, shearing, saw cutting, drilling forming and rolling equipment. Also included will be theory and hands on experiences with metallurgical principles, material types, measuring, tools, and simple structural, sheetmetal, plate and pipe fabrication set ups, inspection and tolerancing.

Synopsis Of Course

A. Contents of the course:

This course if the first of two semesters in the Metal Fabrication Program. The student will learn the safe operation of all Metal processing equipment, the basics of Metal fabrication set up and the fundamentals of metallurgical composition and forms of fabrication materials.

B. Methods to be employed:

Method used in this course is a combination of lecture, practical lab and field experiences. Use of the overhead projector, videos, slide/tape presentations and transparencies are used throughout the course.

C. Building Space and Equipment required:

Classroom space will be adjacent to the lab (fabrication shop). Students will also use the adjacent welding lab for various assignments.

D. Personnel Needed:

Personnel required for course is one instructor for both classroom lectures and supervising the lab sessions.

II. Rationale For the Course

This course is a basic requirement in completing the program for a one-year Vocational Diploma. This course will introduce the student to safety practices, shop layout, and operation of processing and set up equipment as a foundation for an entry level position in a variety of Metal Fabrication industries. Students should possess good mechanical, mathematical and visual skills, and above average hand/eye coordination. High school education is required for entry into this program. Course is on a practical hands on level with emphasis on lab and field experience as well as classroom study. All aspects of safety will be emphasized throughout the course.

III. Course objectives

1. The student will know all general safety hazards associated with Metal fabrication, be aware of specific hazards of all equipment trained to operate, and perform all operations with correct safety procedure and protection.

2. The student will develop proficiency of operation and maintainance of pneumatic and electric powered grinding, chipping polishing, and cleaning tools.

3. The student will develop proficiency of operation and maintainance of hand burn, machine burn and electric arc cutting equipment.

4. The student will develop proficiency in operation and maintainance of power and hand shearing equipment.

5. The student will develop proficiency in operation and maintainance of hydraulic and hand operated forming and rolling equipment.

6. The student will develop proficiency in operation and maintainance of drilling and taping equipment.

7. The student will sellect most effective processing method and perform accurate joint preparation and joining operations on a variety of material forms.

8. The student will gain an understanding of basic metallurgy, the effects of common alloying elements and methods to identify material type.

9. The student will select most appropriate measuring tools for and accurately use to perform all measuring and locating operations used in metal fabrication.

10. The student will develop proficiency in table set up of simple structural, plate, sheetmetal and pipe fabrications.

11. The student will understand the role of inspection and basic inspection and testing procedures and apply techniques of geometric, dimensional and visual inspection to check processing and set up of metal fabrications.

12. The student will start to zero in on specific types of metal fabrication and specific job descriptions that they would like to pursue.

Classroom Policy

1. No eating, drinking in the classroom - no smoking anywhere in the school.

2. No horse play in the classroom or inside and outside the labs.

3. No student will be allowed to work in the labs who is under the influence of alcohol or other drugs.

4. Any disruptive behavior is grounds for removal from the class.

5. All safety rules will be emphasized and followed throughout, the course.

Attendance Policy

Due to the nature and structure of this course, class attendance is of the upmost importance to the successful completion of this course. Attendance will be recorded daily and will become a part of your permanent record. If the student's progress is being hampored due to absences, a referral shall be made to the appropriate student services counselor.

Grading Scale

The following grading scale will be used to numerically determine the student's grade for the course:

A = 93 - 100
B = 85 = 92
C = 77 - 84
D = 70 - 76
F = 0 - 69 (Failing)

Computing Grades

Grades will be figured by adding test points, lab points, and quiz points together and dividing the total possible. The percentage will fall within the scale above.

Total grade determined by the following:

Major Test -)Points will be given for attendance
Quizzes -)and each category listed on left
Lab & Field -)The total number of points will make up 90% of the final grade.
Participation -)10%

Major Tests:

These tests may be made up within 10 school days, but they may not be the same tests.

Quizzes:

Quizzes must be made up within (5) school days or they will be recorded as a zero.

STUDENTS ARE RESPONSIBLE TO MAKE UP TESTS

Labs & Field Work:

Labs are considered as the major part of the class and all students are expected to participate. Labs will not be completed untill all material, tools and equipment has been stored properly and work area cleaned up. Students will not be allowed to leave until formally dismissed by the instructor. An early leave counts as an absence for the day. Students will be graded on initiative, communications, cooperativeness, crew integrity and positive attitude.

Text Required:

1. Metal Fabrication A Practical Guide
2. Metalwork Technology and Practice

Student Material List

1. Tool Box
2. Loose leaf note books & Paper (3ring holder)
3. Pens and pencils
4. Hard toe safety shoes
5. Hard hat
6. Safety glasses w/side shields
7. Gloves
8. Work clothing
9. Combination square
10. Steel punch
11. 12' Steel tape
12. Ball peen hammer
13. Scientific calculator

Job Opportunities

1. Sheet Metal industries
2. Structural steel construction and products
3. Plate Fabrication Products
    a. Construction equipment
    b. Military equipment
    c. Handling equipment
    d. Manfucturing equipment
4. Metal Fabrication Job shops
5. Pipe Fabrication
6. Pressure Vessel Fabrication
7. Ship building industry

Best Students Get The Best Jobs

No guarantee of a job when you graduate
Depends on you
We cannot get you the job

Willingness To Re-locatd For a Job

Don't limit yourself to this area

NWTC - Employment Assistance Center

Main Objectives:

To obtain marketable skills so that you can get a job. You will get out what you put into the class.

Input From Students Encouraged:

Ask questions. We want participation from the students.

COURSE NUMBER 457-311
COURSE TITLE Metal Fabrication 1

STUDENT TEXTS:

Title: Metal Fabrication A Practical Guide
Authors: Robert L O'Con, Richard H. Carr
Publisher: Prentice-Hall Inc., Englewood Cliffs NJ 07632

Date Adopted: 1991 Copyright Date 1985

Title: Metalwork Technology and Practice
Authors: Victor E Repp, Willard J. McCarthy
Publisher: Glencoe Publishing Company
Date Adopted 1991 Copyright Date 1989
Edition 8th

References:
Weldment Distoration - AWS
Pacific Press and Shape Comparr/Corporation and Maintenance Manual
Practical Sheet Metal Layout
Metals Hand Book - Vol 1-10

"A Treatise on Geometric Dimensioning and Tolerancing" by Lowell W Fister, Honeywell Inc.

Visual Aids:
Transparencies taken from above references
Various related videos and slide/tape presentations

Special Equipment and Supplies:
Overhead transparency
Slide projector W/tape
Television and VCR
Screen

SYLLABUS FOR: Metal Fabrication I

TEXT: Metal Fabrication A Practical Guide.
Metalwork Technology and Practice

DATES SESSION TOPICS & BEFORE-CLASS ASSIGNMENTS

Scheduled Actual CLASS SESSIONS: 4 Lecture; 12 Hours Lab

Week #1

__________ ______

1. Basic danger areas in the Metal Fabrication shop.
2. "Safety" Video.
3. Shop layout, material flow, handling equipment. fabrication equipment.
4. Handling equipment - operation.
   Read Chapter 1 Metal Fabrication pp 1-7
   Unit 3 Metalwork pp 34-39
   "Safety Rules" handout
   "Hand control signals" handout

Lab Assignment
   Grinding
   Material Flow
   Material Handling
   Unit 3 Review p 33

Week #2

__________ ______

1. Pneumatic and electric power safety hazards.
2. Operation of grinding equipment
3. Use of metal files
4. Gas cutting principles

Read Chapter 13 Metal Fabrication pp 159-167

Units 43, 44,45 Metalwork pp 361 - 377

Lab Assignment
   Grinding
   Filing

Week #3

__________ ______

1. Hand burn safety
2. Hand burn equipment operation and maintenance
3. Electric arc cutting procedures
4. Plasma arc cutting principles
   Read chapter 12 Metal Fabrication pp 145-158

Lab Assignments
Hand burn plate structural shapes and pipe
Machine track burn shapes and chamfers
Electric arc cutting

Week #4

1. Shearing principles
2. Shearing machine types and accessory equipment
3. Operation of straight blade mechanical shape

Read
Chapter 8 Metal Fabrication pp 95 - 113

Lab Assignments
Straight blade shearing
Rotary shearing

Week #5

1. Steel tapes and rules
2. Squaring tools
3. Angular measuring tools
4. Vernier gauges
5. Dividers and trammel points

Read
Chapter 3 Metal Fabrication pp 24 - 45
Part 4 Metalwork pp 90 - 125

Lab Assignment
Metalwork Review pp 96, 105, 114, 125
Measuring assignment

Week #6

1. Metallurgy - property variables, measures of strength, fabrication considerations, alloying elements.
2. Identification of steel types
3. Material products

Read
Chapter 5 Metal Fabrication pp 62 - 74
Unit 2 Metal Work pp 27 - 33
Chapter 6 Metal Fabrication pp 75 - 81

Lab Assignment
Review p 33
Identification of material types
Identification of material products
Bill of materials

Week #7

1. Sawing equipment safety hazards
2. Sawing variables, cutting fluids, blade
3. Hand hacksaw operation
4. Reciprocating saw operation
5. Abrasive cutoff operation
6. Power hacksaw operation
7. Horizontal band saw operation
8. Vertical band saw operation
9. Cold saw operation

Read:
Unit 15 Metal Work pp 127 - 131
Part 14 Metal Work pp 408 - 421
Chapter 8 Metal Fabrication pp 95 - 102
Tables 7 -1, 7-2, 7 - 3, 7 - 4

Lab
Review Metal Work p 131
Review Metal Work p 415, 421
Cutting Assignment

Week #8 4 - 12

1. Drilling operation safety hazards
2. Drilling equipment and tools
3. Tap & Die equipment and tools
4. Counter boring, counter sinking, spotfacing and reaming operations
5. Operation of portable hand drill
6. Operation of drill press

Read:
Chapter 10 Metal Fabrication pp 121 - 133
Part 15 Metal Work pp 422 - 449
Tables 8 - 1, 8 - 2

Lab
Review Metal Work pp 427, 433, 439, 446, 449
Drill and thread cutting

Week #9

1. Metal Forming principles
2. Metal forming equipment
3. Metal forming safety considerations
4. Operation of finger brake
5. Operation of hydraulic press brake
6. Mid Semester Exam

Read:
Chapter 15 Metal Fabrication pp 177 - 198

Lab Assignment
Sheet Metal forming finger brake
Sheet Metal forming Press brake

Week #10

1. Operation of hydraulic press brake
2. Plate roll principles and components
3. Roll forming safety hazards
4. Operation of pyramid roll

Read:
Chapter 9 Metal Fabrication pp 114 - 120

Lab Assignment
Plate forming - Press brake
Plate Rolling - pyramid rolls

Week #11

1. Processing bevels, chamfers & J Grooves
2. Processing structural steel joints
3. Processing edge and corner flange joints
4. Processing plug and slot weld joints

Read:
Chapter 11 Metal Fabrication pp 134 - 144

Assignment
Joint processing of plate
Joint processing of structural steel
Joint processing of sheet metal

Week #12

1. Set up station orientation
2. Fit up tools
3. Location and layout tools

Lab Assignment
Set up and weld

Week #13

1. Table layout
2. Structural steel fabrications

Lab Assignment
Structural steel fabrication

Week #14

1. Hand notching operations
2. Sheet Metal joint preparation
3. Sheet Metal set up

Read:
  Chapter 16 Metal Fabrication pp 212 - 217
  Chapter 18 Metal Fabrication pp 251 - 262

Lab
  Sheet Metal Fabrications
  Tool Box

Week #15

1. Process plate fabrication piece parts
2. Fabricate plate fabrications

Assignment
  Process, set up & weld plate fabrications

Week #16

1. Pipe Joint preparation
2. Pipe fabrication

Assignment
  Pipe layout fabrication

Week #17

1. Industry tours
    a. Heavy plate
    b. Nautical
    c. Sheet Metal
    d. Pressure vessels
2. Plant organization

Assignment
  Job description work sheet

Week #18

1. Roll of quality control
2. Processing inspection
3. Set up inspection
4. Geometric dimensioning and tolerancing
5. Welding inspection
6. Final exam

Assignment
  Inspection
  Geometric tolerancing
  Tool box assignment due

I. Orientation

  A. Classroom
    1. Equipment
    2. Reference material
    3. Grading

  B. Shop Lab Safety

    1. Protective clothing
    2. Metal Fabrication Hazards
      a. Rotating
      b. Reciprocating
      c. Transverse
      d, Point of action
      e. Non mechanical

    3. Industry safety rules

    4. Worker safety responsibilities

  C. Fabrication shop layout

    1. Shipping and receiving
    2. Scheduling department
    3. Template making
    4. Processing Department
    5. Set up department
    6. Welding department
    7. Machine Shop Department
    8. Quality Control Department
    9. Touch up, clean and paint

II. Handling Equipment

A. Overhead Crane

1. Components
   a. Bridge
   b. Trolly
   c. Hoist

2. Controls
   a. Safety
   b. Operation

3. Pick up equipment
   a. Safety inspection
   b. Hook
   c. Cable
   d. Chain
   e. Slings
   f. Plate Dogs

4. Lift and Travel
   a. Hand signals
   b. Safety
   c. Load
   d. Guidance

B. Jib Cranes

1. Safety
2. Operation
3. Load

C. Fork Lifts

1. Safety
2. Operation
3. Applications
4. Fuel
5. Maintainence

D. Other Handling Equipment

E. Safe Hand Lifts

1. Weight limits
2. Size limits
3. Back, finger and foot injuries

III. Pneumatic and Electric Power Equipment

A. General Hazards

1. Eye and body protection
2. Serious abrasive injuries

3. Demaged discs
4. Damaged and missing guards
5. Improper installation of discs & cups
6. Compressed air leaks, hose couplings, hose wips

B. Use of pneumatic power

1. Connections
2. Hose repairs
3. Line condensation, bleeding
4. Replacement of discs & cups

C. Operation - Disc and cup grinders

1. Protective clothing and eye protection
2. Gripping and pressure
3. Control of direction of sparks
4. Confortable and safe body positioning

D. Operation of pedistal grinders

1. Protective clothing, eye protection
2. Guards
3. Handling and feed of work piece
4. Applications

IV. Gas Cutting

A. Principle

1. A chemical reaction - rapid oxidation
2. Preheat 1400 - 1600 Degrees F
3. Oxygen jet
4. Molten oxide flushed (Kerf)

B. Application

1. Low alloy steel - any thickness
2. Carbon steel - any thickness
3. High alloy & non ferrous - limited application
    a. Resist oxidation
    b. Must add chemical flux/powder

C. General Equipment

1. Oxygen
2. Fuel Gas
    a. Acetylene
    b. Natural gas
    c. Propane
    d. MAPP
3. Regulators and Gages

4. Gas hoses

5. Cutting Torch

6. Replacement cutting tips

D. Types of burning equipment

1. Hand
    a. Application
        (1) Trimming for fit
        (2) Short length cuts & bevels
    b. Advantages
        (1) Portable
        (2) Fast set up
    C. Safety
        (1) Equipment - gloves, goggles w/shaded lenses
        (2) Hazards
            (a) Blow back
            (b) Moltine oxide
            (c) Hose & tank leaks
            (d) Heated work piece
        (3) Procedure
            (a) Position equipment & work piece
            (b) Open fuel lines, check for leaks
            (c) Regulator settings
            (d) Light and adjust torch mixture
            (e) Body positioning
            (f) Preheat
            (g) Pierce
            (h) Tip position
            (i) Travel speed
            (j) Gas off first

2. Guidance Equipment

    a. Metal straight edge
    b. Templates
    C. Radius bar

3. Machine Burn

    a. Portable track guided
        1. Electric variable speed carriage
        2. Runs on track
        3. 2 or 3 hose types

    b. Portable shape cutting machines
        1. Motor driven
        2. Hand guided w/guide wheel
        3. Single torch

c. Stationary shape cutting machines
  1. Motor driven
  2. Separate carrings - longitadinal and transverse travel
  3. Operates multiple torches (1-20)
  4. Can operate with widths to 200"
  5. Tracing
    (a) Manual
    (b) Magnetic
    (c) Electric tracers
    (d) Tape control

E. Maintainance

1. Care and repair of hose
2. Care and handling of fuel tanks
3. Cleaning and care of cutting tips

V. Electric Arc Cutting

A. Air carbon arc cutting
  1. Procedure
    (a) Melting w/heat from electric arc
    (b) Blowing away molten metal with jet of compressed air

  2. Equipment
    (a) Power supply
      (1) Constant voltage
      (2) Direct current (Except copper alloys)
    (b) Air supply
      (1) compressed air
      (2) 80 - 100 PSI
    (c) Electrodes
      (1) Special mixture of carbon & graphite
      (2) Usually coated w/copper
        (a) Increases life
        (b) Increases current
        (c) Reduces radiated heat
    (d) Technique
      (1) Lead angle of electrode
      (2) Speed of travel
      (3) Amount of current
      (4) Done in all positions

    (e) Application
      (1) Prepare grooves
      (2) Cleaning out roots of welds
      (3) Remove weld material

(4) Plbts cutting

VI. Plasma Arc Cutting

A. Principles

1. Confines plasma forming gas in an arc chamber.
2. Arc Supplies large input of electric energy.
3. Control zone of plasma reaches temperatures of 20,000 - 5000 degrees F (completely ionized)
4. No chemical reaction (oxidation)
5. Narrow jet melts and displaces material in path.

B. Selection of Gas

1. Can use any gas not affective tongston electrode (compressed air, argon, nitrogen, hydrogen, oxygen, mixtures
2. Argon, hydrogen, nitrogen and mixtures are used to cut stainless, alluminum, non-ferrous materials.

C. Power Supply - Direct current 4000 volt

D. Application

1. Used on almost any material that conducts electricity.
2. Alluminum alloys up to 8" thick
3. Stainless steel up to 6" thick
4. Clean cuts - free of contaminants
5. Rapid cutting rate

E. Quality of cut

1. Smoother but rounded
2. Walls vee shaped
3. Kerf is greater

F. Safety Precautions

1. Helmets and eye protection (shapes 11 - 12)
2. All skin areas protected from ultraviolet radiation
3. Fumes generated rapidly in confined areas
4. Noise level may require ear protection

VII Metal shearing

A. Principles

1. Stationary lower blade
2. Moveable upper blade
    (a) Penetrates specific portion of work material thickness (low carbon 30 - 60%)
    (b) Unpenetrated portion fractures, separates

3. Quality
    (a) Penetrated - smooth
    (b) Fractured - rough

B. Capacity

1. Rated by section size of low carbon steel (less than 75,000 PSI)
2. High strength alloy - capacity reduced by 2/3 to 3/4.
3. Alluminum - capacity increased by 1 1/4 to 1 1/2.

C. Machine types

1. Straight blade
    a. Squaring (Guillotine) most upper blades at an angle (rake).
    b. Alligator - upper blade moves in an arc.

2. Rotary - straight on contour blades

3. Combination machine (iron worker)
    a. Incorporate several devises within frame for different operations.
    b. Structural shapes.
    c. Punching operations.
    d. Capacity 12 - 100 ton.

D. Drive

1. Mechanical
    a. Most used
    b. Electric motor
    c. Reduction gears

2. Hydraulic
    a. Motor driven pump
    b. Oil into cylinder
    c. Longer strokes
    d. Automatic overload

3. Pneumatic
    a. Compressed air
    b. Strictly for thin material less than 0.060 thick and 5' width.

E. Accessary equipment

1. Hold downs
    a. Types
        1. Mechanical
        2. Hydraulic
        3. Pneumatic
    b. Series of independent units clamp stock of varying thickness w/o adjustment.
    c. Timed automatically with stroke to hit before blade contacts work piece.

2. Back Gages
    a. Adjustable stops.
    b. Permit reproducing of dimensions.

   c. Controlled either manually or by electric motors.
   d. Some equiped with fast traverse, slow speed, gage screws, compensating nuts, precision slides, guides decimal indicators.
   e. Some with electronic sensors - trip only when in position.
   f. Some with magnetic overheads.
   g. Without back gage must notch or scribe.

3. Front gages - stops secured on table on support arm.

4. Squaring arms - extensions at entrance side with linear scale and stops - reversible.

F. Safe operating procedure - straight blade mechanical.

1. Start up - controls
2. Allow flywheel to reach maximum momentum.
3. Set back gage or layout and mark work piece.
4. Make sure all material and personnel are clear from rear
5. Cycle to check stroke and back gauge.
6. Position work piece.
   (a) Make sure work piece is located to contact with hold down units.
   (b) Make sure work piece is on complete contact with back stop
   (c) Make sure hands are-clear from all pinch points and no personnel are behind shear.
7. Engage gage clutch
   (a) Check all clear of pinch points.
   (b) Press foot control to floor.
   (c) Release immediately to avoid double cycling.
   (d) Wait until upper blade has returned to stop cycle position before handling work piece.
8. Remove all stock from front of machine.
9. Shut off machine.
10. Remove all work and drop from back of machine.
11. Never attempt to remove material from behind shear when others are preparing to operate.

G. Operation of rotary shear

1. Principle
2. Capacity
3. Safety hazards
4. Start up
5. Feed

VIII. Measuring and Layout tools and equipment.

A. Measuring

1. Fractional inch
2. Decimal inch
3. Metric
4. Angular, Arc

B. Tools

1. Steel Rules
   a. Applications
   b. Types of graduation and length
   c. Locating and reading
2. Steel Tapes
   a. Applications
   b. Types of graduation and length
   c. Locating and reading
3. Combination Square
   a. Applications
   b. Locating, reading, scribing
4. Precision Square
5. Machinists square
6. Protractors
   a. Applications
   b. Accuracy limitations
7. Vernier Gauges
   a. Caliper
      (1) Applications
      (2) Reading stops
   b. Micrometer
      (1) Applications
      (2) Holding
      (3) Reading
   c. Height Gauge
      (1) Applications
      (2) Holding & scribing
      (3) Reading
8. Dividers and Trammel Points
   a. Applications
   b. Use

C. Marking Tools

1. Soap stone
2. Felt Tip Pen
3. Chalk Line
4. Punch
5. Scribb, dye

IX. Material Properties

A. Metallurgical Property Variables

1. Chemical composition

2. Deoxidation processes
    a. Rimmed
    b. Killed
    c. Lapped

3. Finishing temperature
    a. Hot finished
    b. Cold finished
4. Section Size
5. Chemical uniformity
    a. Quality
        (1) Merchant bar
        (2) Special Bar
        (3) Regular
    b. Internal Soundness
    c. Surface imperfections
        (1) Seams
        (2) Decarburization
    d. Chemical segregation

B. Measures of strength

1. Tensile
2. Fatigue
3. Yield
4. Impact
5. Directional properties

C. Fabricating Considerations

1. Formability
    a. Yield strength
    b. Ductility
2. Machinability
    a. Low carbon - soft (gummy) poor
    b. Carbon to - 5% Good
    c. High carbon - must be annealed
    d. Free machine steels
3. Weldability
    a. Composition
        1. Up to .15% carbon - any method
        2. Up to .3% carbon to 1" thick - any method
        3. Over 3% carbon - preheat, postheat

D. Effects of Alloying Elements
1. Carbon
2. Nickel
3. Chromium
4. Molybdenum
5. Vanadium
6. Tungsten
7. Silicon

E. Material type applications
1. Low carbon non alloy bearing steels
2. Alloy steels
3. Alluminum
4. Magnesium
5. Stainless steel
6. Brass alloys

- F. Identification of Metals
    - 1. Importance
    - 2. Methods
    - 3. NWTC identification procedure

X. Material Products

- A. Sheet and strip
    - 1. Gage thickness
    - 2. Finish
    - 3. Standard short sizes
    - 4. Grain direction

- B. Plate
    - 1. Thickness
    - 2. Standard Plate sizes
    - 3. Grain direction
    - 4. Material identification

- C. Bar
    - 1. Standard sizes
    - 2. Correct size notation
    - 3. Finish
    - 4. Applications

- D. Structural angle, beam and channel
    - 1. Identify by shape
    - 2. Correct size and weight notation
    - 3. Applications

- E. Tubing
    - 1. Identify by shape, size, O.D. and wall
    - 2. Identify by method of fabrication
    - 3. Applications

- F. Pipe
    - 1. Identify by schedle O.D. and wall
    - 2. Applications

- G. Material costs
    - 1. Nesting and material drop
    - 2. Calculations by steel weight
    - 3. Mill 10,000 pounds
    - 4. Warehouse costs

XI. Saw cutting

- A. General safety hazards
    - 1. Rotating and Reciprocating
    - 2. Holding and feeding work piece
    - 3. Burrs
- B. Sawing Variables
    - 1. Metal composition
    - 2. Speed
    - 3. Feed
    - 4. Thickness
    - 5. Effect of stacking

C. Cutting Fluids
  1. Purpose
    a. Overheating - blades soften above 400 degrees
    b. Avoids adherance of blade to work piece
  2. Types

D. Blade design
  1. Pitch
    a. Number of teeth per inch
    b. Minimum of 2 teeth in contact
  2. Blade width - larger width gives greater accuracy
  3. Thickness - standarized by width
    a. 1/2" or less width .025 thick
    b. 5/8" - 3/4" width .032 thick
    c. 1" width .035 thick
  4. Tooth form
    a. Regular
    b. Hook
    c. Carbine inserts
    d. Skip
  5. Blade Materials
    a. Carbon steel
    b. Hardened
    c. High speed bands
    d. Carbide inserts

E. Hand Hacksaw
  1. Components
  2. Blade selection
  3. Blade installation
  4. Holding workpiece safely
  5. Holding and using safely
F. Reciprocating Saw
  1. Components
  2. Safe operation
  3. Applications
G. Abrasive cutoff machines
  1. Safety hazards
  2. Components
  3. Disc
    a. Size - common size 12 - 14 inch diameter
    b. Material aluminum oxide disk

        4. Securing work piece to bed
        5. Feed
        6. Applications

    H. Power Hack Saw
        1. Safety hazards
        2. Components
        3. Blade selection
        4. Applications
    I. Horizontal Band Saws
        1. Safety hazards
        2. Components
        3. Blade selection
        4. Applications
    J. Vertical Blade Saw
        1. Safety hazards
        2. Components
        3. Applications
            a. Straight line cuts
            b. Curved line cuts
            c. Angular cuts
            d. Internal contour cuts
        4. Cutting speed
        5. Blade tension
        6. Blade selection
        7. Operating procedure
    K. Cold Saw
        1. Components
        2. Blades
        3. Applications

XII. Drilling and Taping operations

    A. General safety hazards
    B. Applications
        1. Hole size accuracy length to diameter ratio (3 to 1)
    C. Machine types
        1. Any equipment capable of rotating a tool on a work piece
        2. Hand Feed
            a. Portable hand drill
            b. Magnetic base drills
            c. Hand feed Drill press
                (1) Table to hold work piece
                (2) Vertical driven chuck to hold drill
                (3) Mechansim to lower chuck manually
                (4) Rate and feed controlled by operator
                (5) Operator sense of feel most effective
    D. Drill Types
    E. Dimensional accuracy
        1. Cuts oversize
        2. Accuracy greater than .0005 must drill undersize and ream

F. Pre-drilling
    a. Center drill
    b. Drill can not walk
G. Fixtures and drill bushings
H. Speed and feed
    1. Material types
    2. Drill bit life
I. Cutting Fluids
    1. Cools
    2. Flush chips
J. Counter Sinking & Boring
    1. Tools
    2. Procedure
K. Spotfacing
    1. Tools
    2. Procedure
L. Reaming
    1. Machines
    2. Tools
    3. Procedure
M. Drill Press operating procedure
    1. Components
    2. Safety hazards
    3. Drill Bit selection
    4. Drill bit installation
    5. Table adjustment
    6. Layout and center punch hole location
    7. Work piece allignment
    8. Securing work piece to tables
    9. Controls
    10. Feed and speed
    11. Cutting fluid
    12. Removal and clean up

N. Taping
    1. Process
        a. Produce internal threads
        b. Use of tap threading tool
        c. Hand or machine process
    2. Tooling - hand operation
        a. Solid tap
        b. 4 flutes
    3. Cutting Fluids
        a. Very important - avoid adherance of tap to work piece
        b. Types
    4. Procedures
        a. Determine size pitch and percent
        b. Select correct drill bit size & drill
        c. Select correct tap tool
        d. Apply correct feed, cutting fluid, back off and chip removal procedure
        e. Broken tap removal

XIII. Metal Forming

A. General process - procedures shape to ferrous and non-ferrous metal sheet, plate, bar, structural and in got

B. Forming industries
   1. Stamping industry
      a. Stamping presses
      b. Closed contour dies
      c. Sheet metal products
   2. Forging industry
      a. Forging hammers and presses
      b. Open and closed dies
      c. Bar and ingot stock
   3. Metal Fabricating Industry
      a. Forming presses
      b. Open straight dies
      c. Produce radius on sheet, plate and bar for metal fabrication assemblies

C. Principles
   1. Metal on inside of bend is compressed (shrunk)
   2. Metal on outside is stretched
   3. Bottom dies V shaped
   4. Upper die radiused
   5. Distance upper die enters V die determines bend angle

D. Metal Fabricating forming equipment
   1. Hand operated forming brake
      a. Types
      b. Components of box and pan brakes
      c. Safety hazards
      d. Applications, capacity
      e. Operation
   2. Mechanical press brakes
      a. Ram activited by crank
      b. Shut height is adjustable by means of screw in pitman at each end of ram
      c. Ram stroke is constant

   3. Hydraulic press brake
      a. Ram activated by two double acting cylinders
      b. Length of stroke adjustable
      c. Adjustable ram speed

   4. Press Brake Safety
      a. Considerations
         (1) Number of operators
         (2) Size and type of press
         (3) Size and shape of work pieces
         (4) Length of press stroke
         (5) Number of strokes per minute
   5. Safe guards
         (1) Two hand or foot controls
         (2) Barriers, light guards
         (3) Sweep and pulling devices

E. Hydraulic press brake operation

1. Hazards
    a. Nip points
    b. Material handling
    c. Die set up

2. Nomenclature
    a. Component parts
    b. Dies
3. Press brake start-up
    a. Controls
    b. Die set-up
4. Press Brake Capacity
    a. Types of Bends
        (1) Air bends
        (2) Bottom bends
    b. Air bending force chart
        (1) Tons/foot for mild steel
        (2) Determine width of VEE die
        (3) Determine minimum flange length
        (4) Determine inside radius
    c. Modifications of force chart for differing material types.
        (1) Stainless steel
        (2) Aluminum
        (3) High strength steel
5. Press brake problem solving
    a. Determine how to solve spring back
        (1) Stretch forming
        (2) Over bending
        (3) Restriking
        (4) Use of shims
    b. Methods of solving metal cracking
        (1) Minimum bend radii to avoid cracking
        (2) Checking grain direction

        (3) Ram speed
        (4) Edge condition of plate
        (5) Use of bend relief
6. Press brake die selection
    a. Die materials
    b. Finishing process
    c. Die modifications
        (1) Milled relief
        (2) Tunneling
        (3) Die shaving
        (4) Goose neck dies
7. Sequencing of multiple bends
8. Tilting of punch die

F. Plate roll equipment and operation

  1. Principles
  2. Machine types
     a. Initial pinch
     b. Pyramid
     c. Four roll

  3. Rolling procedure of pyramid roll
     a. Safety hazards
     b. Setting work piece in roll
     c. Reversing
     d. Roll adjustments

XIV. Preparation of Joints

A. Bevels and chamfers
  1. Determing member plate to be beveled
  2. Determing angle of bevel
  3. Determine width of bevel
  4. Layout for bevel processing
  5. Determine method of processing
     a. Factors
        (1) Bevel size
        (2) Bevel length
        (3) Size of plate requiring beveling
        (4) Sequence of processing operation
     b. Methods
        (1) Grind
        (2) Nibbler
        (3) Machine
        (4) Hand Burn
        (5) Portable track burn
        (6) Stationary track burn
  6. Hand burn procedure
     a. Applications
     b. Layout
     c. Angle of Tip
     d. Burn undersize
     e. Improve finish by grinding
  7. Track burn procedure
     a. Applications
     b. Setting tip angle

B. J Grooves and U Grooves

  1. Methods of processing
     a. Machine
     b. Nibbler
     c. Electric arc gouging
  2. Advantages over bevels
     (a) Less distortion
     (b) Less likely hook of slab inclusions
  3. Determination of dept
  4. Determination of width
  5. Determination of radius

C. Root opening set-ups

D. Backing and spacer materials
E. Joining simular and dissimular structural shapes

1. I beam to I beam
2. I beam to channel
3. Channel to channel
4. Channel to angle
5. Angle to angle

F. Joining tube and pipe
  1. Rounds
  2. Square and rectangular
G. Edge and corner flange joints
H. Plugs and slots

XV. Set up station orientation - plate and structural fabrications

A. Table type
  1. Size
  2. Height
  3. Flatness
  4. Levelness
  5. Squareness
  6. Construction material
    a. Cast iron
    b. Heavy steel plate - machine
    c. Structural steel

B. Tacking and welding equipment
  1. Hand arc
  2. Mig
  3. Tig

C. Pneumatic Equipment
  1. Grinding
  2. Air arc
  3. Peen

D. Handling equipment
  1. Overhead crane - extent of reach
  2. Jib lift-extent of reach, capacity
  3. Fork lift access
  4. Chains, plate dogs, slings

E. Fit up tools
  1. Hammers
    a. Peen
    b. 2 pound
    c. 10 pound
    d. sledge
  2. Clamps
    a. Pipe clamps
    b. C Clamps
    c. Vice clamps

        3. Jacks
            a. Pull jacks
            b. Porta powers
        4. Wedges, clips, eyes, angles
        5. Parallels

    F. Table extensions

    G. Layout tools
        1. Squaring tools
            a. Table edge
            b. Machinists squares
            c. Combination squares
            d. Bevel square
            e. Levels
            f. Plumbs
            g. Templates
        2. Straight edges
            a. Combination square
            b. Steel Rules
            c. Table edge
            d. Steel and alluminum
            e. Chalk line
        3. Marking Tools
            a. Soap Stone
            b. Chalk line
            c. Felt tip pens
            d. Die
            e. Dividers
            f. Tramel points
            g. Scribes
            h. Punchs
        4. Measuring Tools
            a. Steel tape
            b. Steel rulers
            c. Combination square
            d. Machinists square
            e. Layout tapes
        5. Leveling tools
            a. Transits
            b. Levels
            c. Plumb line

XVI. Table set-up of structural fabrications
    A. Study print
        1. Identify all detail items
        2. Identify tolerance limits
        3. Identify material type and grades
        4. Identify all fabrication notes

    B. Process piece parts
        1. Determine material requirements
            (a) Structural shapes
            (b) Lengths
            (c) Quantity
            (d) Nesting
            (e) Kerf

2. Determine process method
    (a) Quantity
    (b) Method set-up time
    (c) Processing equipment availability

3. Piece part layout
    a. Produce templates if helpful
    b. Obtain material
    c. Layout
        (1) Nest
        (2) Kerf
        (3) Least drop
4. Processing
    a. Process to shape
    b. Joint preparation
    c. Clean slag, burrs, edges
    d. Complete all required processing (Drilling etc)
    e. Identify by drawing and piece part number and employee ID
5. Table layout
    a. Set-up procedure
        (1) Look for horizontal plane
        (2) Try to start with heaviest members
    b. Prepare layout to horizontal planes determined by set up procedure.
    c. Employ stops & clamps
6. Locate piece parts to layout
    a. Trim to fit layout confines
    b. Clamp
    c. Tack
7. Layout and locate members not on table layout
8. Inspect first fabrication for dimensional accuracy and adjust layout if necessary

XVII. Sheet Metal Fabrication

A. Hand notching machine operation
    1. Components
    2. Capacity - 16 gauge mild steel
    3. Applications
    4. Nibbling and notching procedure

B. Sheet Metal joint types
    1. Notched corners
    2. Mitered flange
    3. Butts
    4. Tees
    5. Lap
    6. Corners
C. Joint connection
    1. Considerations
        a. Joint accessibility
        b. Dimensional stability
        d. Structural stability
        e. Cleanup and finish

2. Methods
    a. Fusion welding
        1. Hand arc
        2. Tig
        3. Mig
        4. Oxyacetylene

    b. Resistance spot and foam welding
        1. Limited to lap joints
        2. Electrically generated heat
        3. High pressure squeezing
    c. Brazing
        1. Does not melt parts being joined
        2. Filler material bonds together
    d. Soldering
        1. Tin and lead fillers
        2. Bonds
    e. Screws
    f. Riveting
        1. Types
        2. Holes
        3. Length
        4. Installation

D. Finishing
    1. Deburring
    2. Belt sanding
    3. Orbital sanding

XVIII. Set-up and welding of plate fabrications.

A. Study blueprint
    1. Identify piece parts
    2. Identify tolerance requirements
    3. Identify fabrication notes

B. Determine material requirements
    1. Material type and grade
    2. Material thickness
    3. Material from bar stock
    4. Plate requirements
    5. Item quantities required
    6. Nesting
    7. Kerf

C. Material Processing
    1. Template requirements
    2. Determine process method
    3. Obtain material by type
    4. Process to shape

5. Process joint preparation
6. Clean burrs, slag, edgess
7. Perform other processing
   (Drill, form, etc)
8. Identify by drawing and piece part number and employee ID.

D. Set Up Procedure
   1. Collect all piece parts and check dimensions and completeness of processing.
   2. Start layout from largest piece part member
   3. Determine piece part assembly sequence
   4. Locate, trim to fit and tack
   5. Check completed fabrication for dimentional accuracy
   6. Brace to combat distortion
   7. Label weld location and size
   8. Identify by drawing number and employee

E. Welding Procedure
   1. Study blueprint
      a. Locate all welding symbols
      b. Identify all welding notes
      c. Determine welding process
      d. Determine welding sequence
         (1) Handling
         (2) Distortion
   2. Positioning of weldment
      a. Length of and size of welds
      b. Size, weight and shape of weldment
      c. Welding process
      d. Accessibility
      e. Deposition rate
         (1) In position
         (2) Flat
   3. Tie in
   4. Weldment cleaning
   5. Touch up welding
   6. Removal of bracing

XIX. Set Up and welding of Pipe and tube fabrication

A. Study pipe layout drawing
   1. Identify pipe and tube size or schedules
   2. Identify pipe and tube lengths
   3. Identify fittings and valve requirements
   4. Identify types of joint connections

B. Pipe processing
   1. Determine rough cut length with coping stock
   2. Use of pipe wrap templates
   3. Burn to fit mating surface
   4. Grind joint preparation
   5. Leave 1" of stock on one end for final fit

C. Fit-Up
    1. Layout center to center dimensions on table or bench
    2. Establish center lines on all pipe and tube ells, tees, etc.
    3. Connect pipe to mating surface on end with most complex coping first.
    4. Line up to table layout centers.
    5. Remove stock, grind joint and fit opposite end to position sub assembly on center line layout.
    6. Continue process until assembly is complete.

D. Welding
    1. Check drawing symbols and notes to determine welding procedure.
    2. Make as many welds as possible on sub assemblies before fitting second end so welds can be made on pipe rollers in position.
    3. Position sub assemblies on pipe rollers and hand turn feed.
    4. Position final assembly in four positions if possible.

E. Clean and touch up welds.

F. Identify assembly by drawing number and employee ID.

XX. Geometric Dimensions and Tolerances

A. Geometric characteristics
    1. Flatness
        a. symbol
        b. tolerance zone
        c. methods to measure
    2. Straightness
        a. symbol
        b. tolerance zone
        c. methods to measure
    3. Angularity
        a. symbol
        b. tolerance zone
        c. methods to measure
    4. Perpendicularity
        a. symbol
        b. tolerance
        c. methods to measure
    5. Parallelism
        a. symbol
        b. tolerance zone
        c. methods to measure
    6. Roundness
        a. symbol
        b. tolerance
        c. methods to measure
    7. Cylindricity
        a. symbol
        b. tolerance
        c. methods to measure
    8. Profile

a. symbol
b. tolerance
c. methods to measure

9. True Position
   a. symbol
   b. tolerance
   c. methods to measure
10. Concentricity
   a. symbol
   b. tolerance
   c. methods to measure

B. Applications
   1. Position
   2. Form
   3. Datum

XXI. Inspection and Testing

A. Importance of dimensional accuracy
   1. Interchangeability
   2. Component parts to larger assemblies

B. Importance of metellugical integrety
   1. Failures related to safety hazards.
   2. Safety hazards related to failures.
   3. Present reliability related to sales.

C. Importance of in process inspection.
   1. First piece inspection.
      a. Check accuracy before large quantities can be produced wrong.
      b. Operator accountability of his work.
   2. Errors become more costly as more labor is put into work pieces.

D. Procedure for checking dimensional accuracy.
   1. Measures with rules and tapes.
   2. Gauges
   3. Squares
   4. Fixtures

E. Procedure for checking geometric dimensions.
   1. Checking diagnals for square.
   2. Straight edges.
   3. Squares.
   4. Fixtures.
   5. Templates.

F. Procedure for checking metalurgical integrety.
   1. Distructive testing.
      a. Bend testing - ductility, soundness.
      b. Tensils testing - tensile, ductility.
      c. Nick Brake Test - structure, soundness.
      d. Impact test - impact strength.
      e. Hardness Test - hardness.
      f. Macro Etch Test - penetration, fusion zone, heat - affected zone.

2. Non destructive Testing
    a. Visual inspection.
    b. Ultrasonic inspection.
    c. Radio graphic inspection.
    d. Magnetic particle inspection.
    e. Penetrant inspection.
    f. Electromagnetic inspection.
    g. Leak tests.
    h. Proof tests.

XXII. Specialized Metal Fabrication Industries

A. Heavy Plate Fabricators
  1. Product types.
    a. Construction equipment.
    b. Handling equipment.
    c. Mining equipment.
    d. Production equipment.
    e. Job shops.
  2. Plant Description
    a. Large, departmentalized.
    b. Jobs highly specialized.

B. Nautical
  1. Fabrication materials.
    a. Wood
    b. Stainless
    c. Alluminum
    d. Bronze
    e. Steel
  2. Types of fabrication
    a. Large heavy plate
    b. Small foundations
    c. Sheet metal
    d. Pipe
    e. Structural steel
  3. Job Description
    a. Some very specialized
    b. Some work as teams
    c. Some do all facets of fabrication

C. Pressure vessel
  1. Product uses
    a. Chemical industry
    b. Paper Industry
    c. Manufacturing
    d. Food processing
  2. Importance of quality control
    a. Product liability
    b. ASME certification
    c. Safety hazards of product failure
  3. Materials
    a. Stainless steel
    b. Spun heads
    c. Fittings and flanges
    d. Pipe and tube

    - e. Large fabricated shells

- D. Sheet Metal
    - 1. Products
        - a. Heating and air conditioning.
        - b. Electrical panels - boxes.
        - c. Heavy machinery cabs.

        - d. Machinery housings.
    - 2. Job description
        - a. Often small shops within large product manufacturing plants.
        - b. Often perform all aspects of fabrication.

- E. Typical Industrial organization
    - 1. Line and staff organization
        - a. Organization manual
        - b. Standard practice manual
    - 2. Departmental organization
        - a. Sales
        - b. Engineering
            - (1) Estimating
            - (2) Production
        - c. Manufacturing
            - (1) Processing
            - (2) Set-Up
            - (3) Welding
            - (4) Machine Shop
            - (5) Quality Control
            - (6) Painting & finishing
        - d. Shipping and receiving
        - e. Scheduling Department

COURSE NO. 457-311-

MODULE/UNIT NO. 1

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6/19/91

TERMINAL COMPETENCY: Identify basic danger areas and hazards in the Metal Fabrication Shop.

LECTURE TIME 1

LABORATORY TIME 3

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Identify Basic Danger Areas:	Lecture and classroom discussion	Read Chapter 1 Metal Fabrication Unit 3 Metalwork
a. Rotating Hazards - collars, couplings, cams, clutches, flywheels, shafts, spindles.	Orientation of shop equipment to identify safety harzards.	Verbal Quizing in class room and shop. Mid Semester exam
b. Reciprocating - components moving back and forth on up and down.	Safety instruction as a key component of all instructional modules.	Observation of safe work habits in the shop.
c. Transverse motions - motions involving a long continuous straight line (bolts, chains).	Supervision of safety rules inforcement in the shop.	
d. Point of operation actions - insertion, holding on removal of stock between machine cycles. (cutting, shearing, punching, banding)		
e. Non mechanical hazards - electrical power compppressed air.		
f. Hand tool hazards		

2. Present Shop Safety Rules
    a. Protective clothing, ear and foot protection.
    b. Mandates of law & company policy
3. Explain worker responsibilies

COURSE NO. 457-311-

MODULE/UNIT NO. 2

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-19-91

LECTURE TIME 2

LABORATORY TIME 6

TERMINAL COMPETENCY: Have a general understanding of fabricating shop layout, material flow and handling, fabricating tools and equipment and specific procedural methods used in the NWTC shop.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Describe and demonstrate shop layout: A. Shipping and Receiving Dept 1. Handling equipment 2. Storage 3. Identification and inventory B. Scheduling Department C. Template making dept D. Processing Department 1. Burning 2. Shear 3. Forming 4. Saw Cutting 5. Handling equipment 6. Machine Shop E. Set Up 1. Handling equipment 2. Pneumatic equipment 3. Grinding 4. Set-up table 5. Welding 6. Storage	Examples of fabrication plant layout and material flow. Tour and evaluation of NWTC shop layout, flow, and fabricating tools and equipment. Students trace the flow of materials and operation of a sample fabrication.	Verbal quizing for understanding Competency in determing flow of sample fabrications.

F. Welding

   1. Machining
   2. Pneumatic equipment
   3. Handling & positioning equipment

G. Machine shop

   1. Machines
   2. Handling
   3. Storage

H. Quality Control

   1. Purpose
   2. Methods

I. Touch up, clean and paint

COURSE NO. 457-311-
MODULE/UNIT NO. 3

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford
DATE 6-18-91

TERMINAL COMPETENCY: Safely operate handling equipment, and choose correct equipment, lifting cables, hook up, signaling, guidance and blocking.

LECTURE TIME 2
LABORATORY TIME 6

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Instruct and train in the use of handling of equipment. A. Overhead Crane 1. Components a. Bridge b. Trolley c. Hoist 2. Controls a. Safety b. Operation 3. Pick up Equipment a. Safety inspection b. Hook c. Cable d. Chain e. Slings f. Plate Dogs 4. Lift & Travel a. Hand Signals b. Safety c. Load	Instruction and supervision of control, hookup, lift & travel of shop overhead crane. Instruction and training on shop fork-truck use and safety. Shop procedures for use, safety inspection and maintenance of all handling equipment. Demonstrate correct procedures for hand pickup and handling.	Observation of individual and team material handling assignments. Verbal quizing for understanding Mid Semester exam.

B. Jib Cranes

   1. Safety
   2. Operation
   3. Load
   4. Applications

C. Forklift

   1. Safety
   2. Operation
   3. Applications
   4. Fuel
   5. Maintenance

D. Other Handling Equipment

E. Safe Hand Lifts

   1. Weight limits
   2. Size limits
   3. Back, foot & finger injuries

COURSE NO. 457-311-

MODULE/UNIT NO. 4

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR

DATE

TERMINAL COMPETENCY: Develop safe working habits and proficiency of operation of pneumatic and electric grinding, tools.

LECTURE TIME 2

LABORATORY TIME 6

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Instruct and train in safe use of pneumatic and electric power grinding and chipping equipment.	Read Chapter 13 Metal Fabrication Unit 43, 44 and 45 Metalwork	Verbal quizing for understanding
Explain A. General Hazards 1. Eye and body protection - dust, particulates. 2. Serious brasing injuries from disc contracts with body. 3. Cracked, damaged discs. 4. Discs worn to unsafe diameter. 5. Damaged and missing guards. 6. Improper installation of discs & cups. 7. Compression air leaks, hose connections and hose wips. 8. Electrical hazards.	List with explanation of safety hazards and severity of injuries caused by use of pneumatic and electric equipment. Shop demonstration, instruction and practice in use of pneumatic & electric grinding & chipping equipment. Assignment to grind wedges and chamfers on work pieces and clean welding booth tops. Assignment to booth file work pieces	Student performance of shop grinding & filing assignments. Mid semester exam

B. Demonstrate use of pneumatic power

1. Connections.
2. Hose inspection and repair.
3. Line condensation, bleeding.
4. Replacement of discs and cups.

C. Demonstrate and instruct in operation.

1. Disc and cone grinders
   a. Protective clothing gloves, eye protection.
   b. Griping and presure
   c. Control of direction of chip
   d. Confortable & safe body positioning.
2. Bench and pedestal grinders
   a. Protective clothing, gloves, eye protection.
   b. Guards.
   c. Handling and feed of work piece.
   d. Heet build up work piece.

D. Application

Assignment to file work pieces
To correct size, shape & finish.

COURSE NO. 457-311-

MODULE/UNIT NO. 5

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

TERMINAL COMPETENCY: Develop safe working habits and proficency of operation in all gas burning operations.

LECTURE TIME 2

LABORATORY TIME 8

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain the principle behind, application and general equipment used in gas cutting operations.	Read Chapter 12 Metal Fabrication Explanation of gas burning principles through lecture w/visual aids.	Verbal quizing to check for under standing. Mid semester exam
2. Describe types of burning equipment. A. Hand burn - application - safety equipment, procedure, maintenance. B. Guidance equipment - metal straight edge, template, radius bar. C. Machine Burn 1. Portable track guided 2. Portable shape cutting 3. Stationary cutting	Demonstration of and supervision of safe operation and maintenance of torch equipment.	Observation of student performance and safety in operation of hand tool guidance equipment and portable tool guided equipment. Grade the smoothness of finish and accuracy of sizing in cut products.
3. Demonstrate and supervise the safe use of hand, guidance and protable machine burn equipment and equipment maintenance.		
4. Demonstrate sequence and procedure for layout and hand burning of structural shapes & pipe.		
5. Demonstrate procedure for torch bevel and chamfer.		

COURSE NO. 457-311-

MODULE/UNIT NO. 6

* NWTC INSTRUCTIONAL PLAN *

INSTRUCTOR Carl Whitford

DATE 6/21/ 91

TERMINAL COMPETENCY: Develop safe working habits and proficancy of operation in electric Arc cutting and gouging.

LECTURE TIME 1

LABORATORY TIME 4

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain the principle behind electric arc cutting, equipment used, techniques and application.	Lecture explaining principles, technique and applications.	Verbal quizing Mid semester exam
2. Demonstrate the technique and procedure for electric arc cutting. 1. Lend angle of electrode. 2. Speep of travel 3. Amount of current. 4. Protective equipment. 5. Done in all positions.	Demonstration of machine and equipment set up, protective equipment and step by step operating procedures. Supervision of student student electric arc cutting and gouging.	Student ability to perform safe and accurate electical cutting and gouging of assigned work.

COURSE NO. 457-311-

MODULE/UNIT NO. 7

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

TERMINAL COMPETENCY: Understand the principles, and applications of plasma arc cutting.

LECTURE TIME 1

LABORATORY TIME

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain plasma arc cutting. A. Principle B. Selection of gas C. Power supply D. Application E. Quality of cut F. Safety precautions	Lecture on principles and application of plazma arc cutting. Show examples of plasma arc cut pieces and compare quality of cut to other cutting methods. Show diagram of plasma arc cutting tips and equipment.	Verbal quizing for understanding Student ability to correctly choose plasma arc cutting methods in process routing assignments. Mix Semester exam

COURSE NO. 457-311-	NWTC INSTRUCTIONAL PLAN	INSTRUCTOR Carl Whitford
MODULE/UNIT NO. 8		DATE 6-21-91

TERMINAL COMPETENCY: Understand the principles and capabilites of all shearing shmachine types and develop safe operating habits in the use of the mechanical ofstraight blade shear with accessories and in the use of rotary shear.

LECTURE TIME 3

LABORATORY TIME 9

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain shearing principles, cutting quality, tolerances, capacity ratings. 2. Describe machine types a. Straight blade 1. Squaring (Guilletine) 2. Alligator b. Rotary c. Iron worker - combination machine 3. Describe types of drives and application. a. Mechanical b. Hydraulic c. Pneumatic 4. Explain the use and purpose of Accessary equipment. a. Hold downs b. Back gages c. Front gages d. squaring arms 5. Demonstrate the safe operating procedure of the straight blade mechanical shear with accessories. 6. Demonstrate the safe operation of the rotary shear.	Read Chapter 8 Metal Fabrication pp 95-113 Lecture on principles, quality tolerance, capacity ratings, machine types, drives and accessories. Extensive demonstration and training on safe operation of mechanical straight blade shear and accessories. Demonstration and training on the safe use of the rotary shear. Assignment to hear various shaped and sized parts from detail drawings.	Verbal quizing for understanding. Close observation of students ability to demonstrate safe operating procedures on straight blade and rotary shear. Inspection of quality, material use, and dimensional accuracy of student shearing assignments.

COURSE NO. 457-311-

MODULE/UNIT NO. 9

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 4

LABORATORY TIME 12

TERMINAL COMPETENCY: Sellect appropriate measuring tools for and correctly and accurately use to perform all measuring and layout operations used in Metal Fabrication.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Discribe the types and gradiation of steel rules and demonstrate the correct ways to position hold and read.	Read Chapter 3 "Metal Fabrication" Part 4 Metal work.	Verbal quizing to check for understanding.
2. Describe the framing, machinists, precision and combination squares and demonstrate correct ways to position and use.	Lecture and describe each type of measuring tool, its application and use.	Ability of students to select correct measuring tool and positi hold and read with accuracy on measuring assignments.
3. Describe and demonstrate the uses of protractors and the degree of accuracy limiting uses.	Demonstration of the use of each type of measuring tools.	
4. Describe the types, degree of accuracy and principle involved in reading and demonstrate how to position and read vernier gauges.	Assignments using each type of measuring tool.	
5. Demonstrate the use and application of dividers and trammel points.		

COURSE NO. 457-311-

MODULE/UNIT NO. 10

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

TERMINAL COMPETENCY: Possess a basic understanding of Metalluragy principles, the effects of common alloying elements in steel, alluminum, stainless steel, brass, and methods to identify steel types.

LECTURE TIME 2

LABORATORY TIME 4

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Define Metallurgy	Read Chapter 5 "Metal Fabrication" Read Unit 2 Metalwork	Verbal quizing to check for understanding.
2. Describe metallurgical property variables a. Chemical composition b. Deoxidation processes c. Finishing temperatures d. Section size e. Chemical uniformity	Lecture explaining steel mill operations measure of strength and material selection considerations.	Mid semester exam. Ability of students to identify material types by visual inspection and workability.
3. Describe measures of strength a. Tensils b. Fatique c. Yield d. Impact e. Directional properties	Lecture explaining the effect of alloying elements to seel, stainless steel and alluminum. Opportunities for students to process and work with a variety of material and to visually inspect appearances and density of material type.	
4. Describe Fabricating Considerations a. Formability b. Machine ability c. Weldability		
5. Explain the effects of Chemical alloying elements.		
6. Explain applications of Fabrication Materials by classification. 1. Low carbon non-alloy bearing steels. 2. Alloy steels. 3. Alluminum 4. Magnesium 5. Stainless steel 6. Brass Alloys		
7. Describe the ways of identifying steel types and explain the importance of and the Procedure [illegible] to identify steel by types and thick - ness immediately as it enters the shop.		

COURSE NO. 457-311-

MODULE/UNIT NO. 11

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitf ord

DATE

TERMINAL COMPETENCY: Identify material products by finish process, shape, weight and alloy classification number.

LECTURE TIME 2

LABORATORY TIME 8

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate material classification by size, shape, weight and finish and the correct notation form for all sheet plate bar structural, tube, and pipe.	Read chapter 6 Metal Fabrication Lecture and discussion. Show examples of common structural shapes and methods to measure to determine size specification.	Verbal Quizing Student ability to identify sampl structural shapes, cold and hot finished bars, sheet metal and pi
2. Explain and demonstrate material classification by chemical composition and show commonly used number designations.	Use channel beam and pipe tables to determine dimension and weights. Show and use SAE & AISI steel clasification charts identifying material product samples. Prepare bills of material from sample drawings.	Student ability to prepare bills material using correct order of notation. Mid semester exam

COURSE NO. 357-311-

MODULE/UNIT NO. 12

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

TERMINAL COMPETENCY: Select the appropriate saw cut process method and perform the process in a safe and efficient manner within dimensional tolerances.

LECTURE TIME 4

LABORATORY TIME 12

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Identify general safety hazards associated with using sawing equipment.	Read Chapter 8 Metal Fabrication Read Unit 15 Part 14 Metal Work PP 95 - 163	Verbal Quizing Mid Semester Exam
2. Explain sawing variables - Metal composition, speed, feed, thickness and effect of stacking.	Demonstration of safe and correct operations of hand hack saw, reciprocating saw, abrasive cut off machines, power hack saw and vertical band saw.	Student performance in completing cutting assignments per procedure check lists.
3. Explain types and purposes of cutting fluids.		Accuracy and efficency in saw assignment processing.
4. Describe blade design variables. a. Pitch b. Blade width c. Blade thickness d. Tooth form e. Blade materials	Lecture and discussion. Cutting assignments utilizing all hand and power cutting equipment. Tables: "Band Saw widths and Pitches" "Cutting Speeds for Power Hacksaws" "Cutting Speeds for Band Saws" "Band Saw Blade Sizes"	
5. Explain and demonstrate use of hand hacksaw.		
6. Explain and demonstrate the use of the reciprocating saw.		

7. Explain and demonstrate the use of abrasive cut off machines.

8. Explain and demonstrate use of the power hacksaw.

9. Explain the use of horizontal band saws.

10. Explain and demonstrate the use of vertical band saws.

11. Explain and demonstrate installation of band saw blades including welding of blades for internal cutting.

12. Explain and describe the use of cold saws.

COURSE NO. 457-311-

MODULE/UNIT NO. 13

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 4

LABORATORY TIME 12

TERMINAL COMPETENCY: Select correct tools and equipment and accurately perform drill, counter sink, counter bore, spot facing, tap and threading operations.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Identify hazards involved with drill operations.	Read Chapter 10 Metal Fabrication Part 15 " Metal Work" Lecture and discussion	Verbal quizing Mid Semester Exam
2. Identify types of drill equipment and applications. a. Portable hand b. Magnetic Base c. Drill Press	Handout: Decimal equivalents of fractional, numbered. and letter size drills.	Student ability to safely operate all drill equipment and select correct drill taps and dies to perform accurate drill, tap and thread assignments.
3. Explain drill types, cutting fluid purpose and use speed and feed variables.	Handout: Drill speeds for cast iron and steel. Handout: Tap drill sizes	
4. Identify types of taps and dies and demonstrate correct selection and use of drill bit, tap and die.	Demonstration of equipment operation by instructor.	
5. Explain and demonstrate procedures and tooling to perform counter sinking, counter boring, spotfacing and reaming operations.	Assignments using drill & thread cutting equipment.	
6. Demonstrate correct procedure to operate portable hand drill and drill press.		

COURSE NO. 457-311-

MODULE/UNIT NO. 14

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

TERMINAL COMPETENCY: Understand bending principles and safety holders. Select correct forming equipment & dies, and perform bending operations using correct procedures for set up and operation with accuracy and efficiency.

LECTURE TIME 6

LABORATORY TIME 24

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain the general principles included in the Metal forming, stamping, forging, and Metal Fabrication industries.	Read Chapter 15 Metal Fabrication PP 177 - 198	Verbal quizing Mid Semester Exam
2. Describe Metal Fabrication forming equipment a. Hand operated b. Mechanical Press Brake c. Hydraulic Press Brake	Lecture and classroom discussion Demonstration of hazards set up and operation of finger brake, hydraulic press brake and plate rolls by instructor	Observation of safe student operation of hand and hydraulic pre brake.
3. Explain general safety considerations - number of operators, size and type of press, size and shape of work piece, length of press stroke, number of strokes per minute.	Forming assignments with sheet metal, plate steel, alluminum and stainless steel.	Quality and accuracy of forming a signment using correct die selection. Set up & operating procedur
4. Describe Safe Guards a. Two hand or foot controls b. Barriers - light guards c. Sweep and pulling devices		
5. Identify hazards and components of the hand operated finger brake.		

6. Describe application, capacity and limitation of the finger brake.
7. Demonstrate methods to set and make ajustments.
8. Demonstrate proper use and safety in performing forming operations on the finger brakes.
9. Identify hazards and components of the Hydraulic Press brake.
10. Diffferentiate between types of dies used in the operation of various bends.
11. Determine tonage capacity for power press brakes.
12. Explain bend sequence for multiple bends.
13. Explain the purpose of using bend relief slots and holes.
14. Explain and demonstrate the function and procedure of bump bending.
15. Differentiate between air and bottom bending.
16. Explain and demonstrate die selection and capacity by use of air bending force chart and modifications for material types.
17. Explain procedures to solve press brake problems.
18. Demonstrate die set ups, and explain die materials and die modifications.

COURSE NO. 457-311-

MODULE/UNIT NO. 14 (Continued)

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR

DATE

TERMINAL COMPETENCY:

LECTURE TIME

LABORATORY TIME

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
19. Explain the general principles and and components of plate rolls.	Read Chapter 9 Metal Fabrication pp 114 - 120	Quality & accuracy of completing rolling assignments.
20. Describe the 3 types of plate roll and compare work capabilities of each.		Semester Exam
21. Identify safety hazards involved with plate rolling.		
22. Demonstrate the procedure to set up and operate the pyramid roll.		

COURSE NO. 457-311-
MODULE/UNIT NO. 15

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR ____________
DATE ____________

TERMINAL COMPETENCY: Select most effective processing method and performing with accuracy joint preparation and joining operations as specified by drawing details and welding symbols.

LECTURE TIME 1
LABORATORY TIME 15

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain how to determine bevel require- methods of processing for bevels chamfers vee grooves, J and U grooves.	Read Chapter 11 Metal Fabrication Lecture and discussion	Verbal quizing Semester Exam
2. Demonstrate methods of processing bevels & chamfer and J grooves. a. Grind b. Nibbler c. Machine - Milled, turned d. Hand burn e. Portable track burn f. Stationary tanck burn g. Electric arc gauging	Interpretation of Blue Print welding symbols from sample drawings. Cross sectional views of prepared joints. Student assignments to process from print welding symbols bevels, chamfors, U grooves, corner, edge flange, plug and plot joints.	Ability ot perform process and joining assignments with accuracy and efficiency.
3. Demonstrate and explain preparation for joining simular and dissimular structural shapes.	Assignments to process and join structural shapes.	
4. Demonstrate the procedure for preparing edge and corner flange joints.		
5. Demonstrate the procedure for preparing plug and slot joints.		

COURSE NO. 457-311-

MODULE/UNIT NO. 16

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitf ord

DATE

LECTURE TIME 1

LABORATORY TIME 13

TERMINAL COMPETENCY: Be familiar with set up station layout and all the tools and equipment used to locate and know the functions and hazards of fit upabrications. equipment.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate typical set up station equipment and layout. a. Table b. Welding & tacking equipment c. Pneumatic lines and equipment d. Handling equipment	Lecture and discussion Orientation demonstration of set up station.	Verbal quizzing Semester exam Student ability to safely and accurately use fit-up and location tools in set-up assignments.
2. Explain and demonstrate the safe use of typical fit up tools. a. Hammers b. Clamps - Pipe, C Vice clamps c. Jacks - pull, porta powers d. Clips, angles, wedges, eyes	Demonstration of the use of pull jacks, Porta-powers, clips, angles, eyes and wedges. Demonstration of the use of marking, leveling, squaring and measuring tools. Assignments requiring use of fit up and location tools.	
3. Explain and demonstrate location and layout tools. a. Squaring tools b. Straight edges c. Marking tools d. Measuring tools e. Leveling tools		

COURSE NO. 457-311-

MODULE/UNIT NO. 17

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR

DATE

TERMINAL COMPETENCY: Prepare and affectively use table layouts combining stops, clamping, parallels, leveling and squaring equipmdent to produce structural fabrications.

LECTURE TIME 4

LABORATORY TIME 12

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Demonstrate the use and preparation of table layouts with stops, clamping, parallels, leveling and squaring for typical structural fabrications.	Lecture and discussion Demonstration of table layouts for structural fabrications.	Verbal quizzing Semester exam Student ability to prepare and use accurate table layouts.
2. Combine structural processing, Blueprint reading, and table layout skills to process set up and weld structural fabrications from Blueprints.	Assignments to prepare and use table layouts to setup structural fabrications.	Ability to produce a high quality structural fabrication in an efficient manner.

COURSE NO. 457-311-
MODULE/UNIT NO. 18

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitf ord
DATE

LECTURE TIME 4
LABORATORY TIME 12

TERMINAL COMPETENCY: Safety and effectively use sheet Metal processing equipment and perform quality fitting and joining of sheet metal products.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate set up and safe operation of the hand notching machine. 2. Explain and demonstrate common sheet metal joint preparation and connection. 3. Supervise students to use their knowledge and developing skills in processing operations to select processing method and proceed to process tool box assignment. 4. Students fabricate, weld and finish tool box assignment.	Read chapter 18 Metal Fabrication Chapter 16 Metal Fabrication. Lecture & discussion Demonstration of set up and operation of hand notching machine. Students fabricate tool box from designed layout assignments.	Verbal quizzing Semester Project Student ability to set up and safely operate hand notcher. Student ability to determine most effectove processing methods for assignment. The degree of quality in processing and fit up in fabrication of the assignment

COURSE NO. 457-311-

MODULE/UNIT NO. 19

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR

DATE

TERMINAL COMPETENCY: Safely and effectively use plate processing equipment and and perform quality fit up and welding of plate fabrications from simple assembly drawings.

LECTURE TIME 1

LABORATORY TIME 15

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Demonstrate procedure to set up simple steel plate fabrications from assembly drawings.	Lecture and discussion	Verbal quizzing
	Demonstration of plate fabrication set up procedure.	Semester exam
2. Supervise students to use knowledge and developing skills in processing operations to select appropriate processing methods and proceed to process plate fabrication assignments.	Assignment to process, set up and weld plate fabrication from assembly drawings.	Ability to choose effective processing set up and welding methods. For assignments.
3. Students determine best set up procedure and proceed to set up and weld plate fabrications.		Quality of processing and set up assignment.

COURSE NO. 457-311-
MODULE/UNIT NO. 20

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR
DATE

LECTURE TIME 2
LABORATORY TIME 14

TERMINAL COMPETENCY: Safety and effectively use processing equipment and perform correct layouts and joint connections of simple tube and pipe fabrications from typical single and double line pipe drawings.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate joint preparation and connection methods as interpreted from pipe drawing symbols.	Lecture & discussion	Verbal quizzing
	Demonstration of pipe joining methods.	Semester exam
2. Explain and demonstrate layout and fabrication of pipe layouts as interpreted from simple pipe drawings.	Assignments in processing and fabricating pipe assemblies from single and double line pipe drawings.	Ability to and choose effective method and accurately process assignment pipe joints. Quality of finished pipe assembly assignments.

COURSE NO. 457-311-

MODULE/UNIT NO. 21

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 4

LABORATORY TIME 16

TERMINAL COMPETENCY: Students start to zero in on specific types of metal fabrication and specific job descriptions that they would like to pursue.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Describe the type of metal fabrication products produced and the nature of the metal fabrication work performed by the work force of specific sheet metal, heavy plate, nautical and pressure vessel fabricating companies to be toured.	Lecture and discussion 4 shop tours of sheetmetal, heavy plate, pressure vessel and nautical fabrications.	Verbal quizzing Enthusiasum comments & questions generated during plant tours.
2. Show fabrication shop operations identifying by department the equipment and use, the products fabricated and worker job description.	Assignment to choose one specific fabrication shop and a specific job description and complete work sheet listing tools equipment and job skills used.	Type of fabrication shop and job description choosen and ability to list complete tools, equipment and job skills used. Demonstration of plant organizati charts, organizational manuals

Demonstration of plant organization charts, organizational manuals.

and standard practice manuals.

COURSE NO. 457-311-

MODULE/UNIT NO. 22

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 2

LABORATORY TIME 6

TERMINAL COMPETENCY: Apply techniques of dimensional and visual inspection to check processing and set up of fabrications and have an understanding of distructive and no distructive testing procedures to test welding and metallurgical properties.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain the purpose and roll of quality control in all aspects of metal fabrications and the need for metal fabricators to perform inspection of their work.	Lecture and discussion. Demonstration of dimensional inspection procedures for size, form and position.	Verbal quizzing Semester Exam
2. Explain and demonstrate inspection of process operations for dimensional accuracy, finish and completeness of operations.	Assignments to check fabrications for size form, position, and visual inspection of welding, fit up and finish.	Student ability to accurately check processins set up and make sound visual inspection judgements on welding repairs and use weld gauges to check for correct sizing of welds.
3. Explain and demonstrate inspection of fit-up of fabrications prior to welding.		
4. Explain and describe inspection of fabrications after welding. a. Explain distructive testing methods. b. Explain and descrivbe non destructive methods. c. Explain and demonstrate the use of welding gauges to inspect weld size.		

COURSE NO. 457-311-

MODULE/UNIT NO. 23

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR

DATE

LECTURE TIME 2

LABORATORY TIME 6

TERMINAL COMPETENCY: Identify geometric symbols, correctly interpret feature control symbols and perform fabrication set-up meeting all feature control symbol requirements.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain geometric characterestics and show what form or position each dimensions.	Lecture and discussion	Verbal quizzing
2. Explain this purpose of geometric tolerancing and dimensioning and list the cases where it should be used.	Geometric tolerancing handout	Semester exam
	Demonstration of correct methods to set up and check fabrications to confine to geometric tolerancing.	Ability to interpret geometric feature control symbols to layout set up and check fabrications to meet geometric tolerances.
3. Demonstrate the correct methods of measuring and set up to hold geometric tolerances of form and position.	Assignments to set up fabrications and check layouts from drawings specifing geometric tolerancing.	

BLUEPRINT READING AND SKETCHING

COURSE SYLLABUS

I. SUMMARY STATEMENT

Metal Fabrication
Blueprint Reading and Sketching
421-352- 2 Credit Hours

Office Location:
Telephone Number: (414) 743-2207
Advising time:

This course includes lecture, text bookkeeping and work assignments to develop and sharpen Blueprint Reading skills including identifying the components of orthographic projection, working with fractional, decimal, metric and geometric dimensions, interpreting brakes, developed views, auxiliary views, partial views and sectional views, analyzing revisions and interpreting welding symbols, finish symbols, and abreviations and other information in notation form used in metal fabrication drawings.

Synopsis Of Course

A. Contents of the course:

This is a required course in the Metal Fabrication Program and must be taken simultaneously with Metal Fabrication I. The student will learn Basic Blueprint Reading skills and specific terminology and Blueprint Reading skills used in the Metal Fabrication industry.

B. Methods to be employed:

This course will follow the organization of the text book, incorporating the use of typical industry blueprints and examples of welded fabrications. There will be extensive classroom discussion and checks for understanding. Work assignments will be a major part of learning, assessing understanding and grading.

C. Building Space and Equipment required:

Classroom space will be adjacent to the lab (fabrication shop). Students will also use the adjacent welding lab for various assignments.

D. Personnel Needed:

Personnel required for course is one instructor for classroom lectures and assignments.

II. Rationale For the Course

This is a basic foundation course in completing the Metal Fabrication program. The course will introduce the student new to Blueprint Reading the basics of orthographic projection. The course will progress to focus on specific aspects of blueprint reading used in the Metal Fabrication industry. The student will work with typical industry blueprints, extensive classroom work assignments, and reading assignments. The cousee content will parallel closely the projects and lecture content of Metal Fabrication I.

III. Course objectives

1. The student will identify the components of orthographic projection and employ these in developing drawings of sample fabrications.

2. The student will effectively work with fractional, decimal, metric and geometric dimensions and tolerances.

3. The student will develop skills in interpreting brakes, developed views, auxiliary views, partial views, enlarged detail views and sectional views.

4. The student will prepare bills of materials, calculate material weights and method of processing for a variety of assembly drawings.

5. The student will analyze revisions to determine reasons and significance of changes.

6. The student will interpret welding symbols, finish symbols, commonly used abreviations and other information in notation form used in fabrication drawings.

Classroom Policy

1. No eating, drinking in the classroom - no smoking anywhere in the school.

2. No horse play in the classroom or inside and outside the labs.

3. No student will be allowed to work in the labs who is under the influence of alcohol or other drugs.

4. Any disruptive behavior is grounds for removal from the class.

5. All safety rules will be emphasized and followed throughout, the course.

Attendance Policy

Due to the nature and structure of this course, class attendance is of the upmost importance to the successful completion of this course. Attendance will be recorded daily and will become a part of your permanent record. If the student's progress is being hampored due to absences, a referral shall be made to the appropriate student services counselor.

Grading Scale

The following grading scale will be used to numerically determine the student's grade for the course:

A = 93 - 100
B = 85 = 92
C = 77 - 84
D = 70 - 76
F = 0 - 69 (Failing)

Computing Grades

Grades will be figured by adding test points, lab points, and quiz points together and dividing the total possible. The percentage will fall within the scale above.

Total grade determined by the following:

Major Test -)Points will be given for attendance
Quizzes -)and each category listed on left
Lab & Field -)The total number of points will make up 90% of the final grade.
Participation -)10%

Major Tests:

These tests may be made up within 10 school days, but they may not be the same tests.

Quizzes:

Quizzes must be made up within (5) school days or they will be recorded as a zero.

STUDENTS ARE RESPONSIBLE TO MAKE UP TESTS

Labs & Field Work:

Text Required:

1. Blueprint Reading For Welders

Student Material List

1. Loose leaf note books & paper (3 ring holder)
2. Pens and pencils
3. Safety glasses w/side shields
4. 12' Steel tape
5. Scientific calculator

Job Opportunities

1. Sheet Metal industries
2. Structural steel construction and products
3. Plate Fabrication Products
   a. Construction equipment
   b. Military equipment
   c. Handling equipment
   d. Manfucturing equipment
4. Metal Fabrication Job shops
5. Pipe Fabrication
6. Pressure Vessel Fabrication
7. Ship building industry

Best Students Get The Best Jobs

No guarantee of a job when you graduate
Depends on you
We cannot get you the job

Willingness To Re-locatd For a Job

Don't limit yourself to this area

NWTC - Employment Assistance Center

Main Objectives:

To obtain marketable skills so that you can get a job. You will get out what you put into the class.

Input From Students Encouraged:

Ask questions. We want participation from the students.

COURSE NUMBER 421-352-
COURSE TITLE Bluepring Reading and Sketching

STUDENT TEXTS:

Title: Bluepring Reading For Welders
Authors: A. E. Bennett, Louis J Siy
Publisher: Delmar Publishers, Inc.
Date Adopted: 7-91 Copyright Date 1988
Edition: 8th

Visual Aids:
#907 Blueprint Reading For Metal Fabrications and Welders
Bergwall Copyright: 1984

Video I	Line and View Interpretation
Video 2	Size and Location Dimensions
Video 3	Additional views and supportive information
Video 4	Welding symbols Part I
Video 5	Welding Symbols Part II

"Orthographic Projection" Slide Presentation
Transparencies From Textbook

Special Equipment and Supplies:
Slide projector and screen
VCR and television
Transparency projector

SYLLABUS FOR: Bluepring reading and Sketching

TEXT: Blueprint Reading For Welders, 4th Edition by A. E. Bennet and
Louis J. Sly, Delmar Publishers Inc., 1988

DATES SESSION TOPICS & BEFORE-CLASS ASSIGNMENTS

Scheduled Actual CLASS SESSIONS: 1-Hour Lecture; 3-Hours Shop

Week #1

________ ______ Class organization; course introduction and summary; course objectives and methods.

Purpose and makeup of prints, Orthographic Projection, basic lines and views.
Video I

Read: pgs. Preface, pgs. 1-7
Questions: Unit 1 Review A, Unit 1 review B

Week #2

________ ______ Basic sketching techniques, Methods used for developing isometric and oblique drawings.
Purpose and use of notes and specifications.

Read: pgs. 12-21; 28-29
Questions: Unit 2 Review; Unit 3 Review

Week #3

________ ______ Purpose and use of dimensions, application of liear, angular, radius and arc dimensions, holes and thread dimensions, scale and tolerance dimensions, preparation of Bills of Materials.
Video 2

Read Pgs. 32-43
Questions Unit 4 Review A, Review B, Summary
Review #1

Week #4

________ ______ Common structural shapes

Read: Pgs; 54-66
Questions: Unit 5 Review A, Review B, Review C, Review D, Review E

Week #5

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Other Views, Sections
Video #3
Read: Pgs: 79-87, 96-99
Questions: Unit 6 Review A, Review B, Review C
Review D, Review E; Unit 7 Review A, Review B,
Review C

Week #6

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General abbreviations and symbols
Welding symbols and abbreviations

Read: Pgs; 110-111, 113-127
Questions: Unit 9, Unit 10, Review A, Review B
Video 4

Week #7

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Basic joints

Read: Pgs; 142-148
Questions: Summary Review 2A, 2B
Unit 11 Review

Week #8

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Fillet Welds
Video 5
Read: Pgs; 153-157
Questions: Unit 12 Review A, Review B

Week #9

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Groove Welds

Read: Pgs; 162-169
Questions: Unit 13 Review A, Review B, Review C
Review D

Week #10

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Back and Backing welds, melt thru welds,
Plug and slot welds

Read: Pgs; 180-182; 185-188
Questions: Unit 14 Review, Unit 15 Review

Week #11

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Surfacing welds, flange welds

Read: Pgs; 194-195; 198-200
Questions: Unit 16 Review, Unit 17 Review

Week #12

Spot welds, projection welds, seam welds

Read: Pgs; 203-206; 210-211; 214-216
Questions: Unit 18 Review, Unit 19 Review,
Unit 20 Review

Week #13

Stud Welds, standard welding symbols

Read: Pgs; 220-221, 224-230
Questions: Unit 21 Review, Summary Review #3A
Summary Review #3B

Week #14

Pipe welding symbols

Read: Pgs; 245-251
Questions: Unit 23 Review

Week #15

Applied Metrics

Read: Pgs; 257-264
Questions: Unit 24 Review A, Review B

Week #16

Dual Dimensioning

Read: Pgs; 275-283
Questions: Unit 25 Review A, Review B, Review C,
Review D, Review E

Week #17

Inspection and Testing
Geometric Tolerancing's dimensioning
Read: Pgs; 294-301, Handout - Geometric tolerancing
and dimensioning
Questions: Unit 26 Review

Week #18

Geometric Tolerancing, Review
Final Exam

BLPTRE[illegible] N

COURSE OUTITLE AND REQUEST ROE
COURSE APPROVAL (CONTINUED)

COURSE NUMBER 421-352-
COURSE TITLE Blueprint Rdg & Sketching

COURSE OUTLINE:

Text: Blueprint Reading For Welders 4th Edition
A. E. Bennet and Louis J Siy

I. Purpose and Make up of Prints

   A. Transfer of calculations and ideas

   B. Tracing on clear and translucent paper

   C. Computer aided drafting (CAD)

II. Basic Lines and Views

   A. Lines

      1. Object

      2. hidden

      3. center

      4. extension

      5. dimension

      6. leaders

      7. section

      8. section

   B. Basic Views

      1. pictorial

      2. orthographic projection

III. Notes and Specifications

   A. general

   B. specific

   C. specification block

- IV. Dimensions
  - A. Purpose
    - 1. Size
    - 2. location
  - B. Types
    - 1. linear
    - 2. angular
    - 3. chamfer - bevel
    - 4. radius - arc
    - 5. hole
    - 6. tolerance
    - 7. thread
  - C. Scale
  - D. Dimensioning methods
    - 1. Conventional - chain
    - 2. baseline
  - E. Bill of Materials
- V. Structural Shapes
  - A. Gage size
    - 1. hot rolled
    - 2. cold rolled
    - 3. sheet
    - 4. plate
  - B. Weight
    - 1. channels
    - 2. beams
  - C. Common structural shapes
    - 1. bar

2. angle

3. channel

4. tubing

5. pipe

VI. Other views

A. breaks

B. Auxiliary views

C. alternate positions

D. Enlarged details

E. Developed views

F. Revolved sections

G. Untrue Projection

H. Revisions

VII. Sections

A. Full

B. half

C. Revolved

D. Assembly

E. Phantom

F. Aligned

VIII. Detail and assembly prints

A. Assembly drawings with details

B. Assembly drawings without details

C. Detail drawings

IX. General Abbreviations and symbols

X. Welding Symbols

A. Lines

B. Location

- C. Additional elements
- D. Contour, finish symbols
- E. Multiple Symbols
- F. Designation of member to be beveled
- G. Dimensions
- H. Special Information
- I. Location of the Symbol
- J. Duplicate Welds
- K. Multiple Weld operations
- L. Welding Abbreviations

XI. Joints and Preparation

- A. Basic Joints
  - 1. Butt joints
  - 2. Corner
  - 3. Tee joints
  - 4. Lap joints
  - 5. Edge joints
- B. Other Joints
  - 1. Corner flange
  - 2. Edge Flange
  - 3. Flare bevel groove
  - 4. flare vee groove
  - 5. Scarf joints
- C. Joints used with structural shapes
  - 1. Joining simular shapes
  - 2. Joining dessimular shapes
  - 3. Joints formed by cutting and bending
- D. Joint fit-up

XII. Fillet Welds

   A. Size of the legs
   B. Length of welds
   C. Extent of weld
      1. Section lining
      2. Multiple arrows
      3. Intermittent welds
   D. Contour and Finishing
   E. Fillet in combination with other welds

XIII. Groove Welds

   A. Symbols and Types
   B. Depth of preparation
   C. Weld Size
   D. Root opening
   E. Included angle
   F. Contour, Finishing
   G. Groove weld combinations
   H. Back Gouging
   I. Backing and Spacer symbols
   J. Consumable Inserts
   K. Seal Welds

XIV. Backing and Melt Thru Welds

   A. Purpose
   B. Size
   C. Contour and finishing
   D. Application

XV. Plug and Slot Welds

- A. Purpose
- B. Size
- C. Angle of Countersink
- D. Depth of fill
- E. Number Required
- F. Pitch
- G. Contour and Finishing
- H. Plug welds of three or more joints

XVI. Surfacing Welds

- A. Purpose
- B. Symbol
- C. Length, width
- D. Direction of build up
- E. Applications

XVII. Flange Welds

- A. Purpose
- B. Dimensions
- C. Application
  - 1. Edge Flange
  - 2. Corner Flange

XVIII. Spot Welds

- A. Purpose
- B. Dimensioning
  - 1. Size
  - 2. Shear strength
  - 3. Spacing, pitch
  - 4. Extent

        - 5. Location
    - C. Contour and finishing

- XIX. Projection Welds
    - A. Purpose
    - B. Application
    - C. Elements
        - 1. Size
        - 2. Spacing
        - 3. Extent
        - 4. Number
        - 5. Process
- XX. Seam Welds
    - A. Purpose
    - B. Elements
        - 1. Process
        - 2. Size
        - 3. strength
        - 4. length
        - 5. extent
        - 6. pitch
    - C. Flush countour symbol
    - D. Multiple joint seams
- XXI. Stud Welds
    - A. Application
    - B. Elements
        - 1. Size
        - 2. Pitch

3. Number

4. Spacing

XXII. Pipe Welding Symbols

A. Symbols, fittings

1. ASME symbols

2. Company symbols

a. single line

b. double line

B. Symbols

C. Joint connections

D. Pipe layouts

1. Pictorial

2. Orthographic

E. Dimensioning pipe layouts

XXIII.Applied Metrics

A. Structure

1. Base units

2. Supplementary units

3. Derived units

B. Metric Prefixes

C. Iso Screw Threads

D. Pipe thread designations

E. Metric materials

F. Standard practices of use

XXIV. Dual Dimensioning

A. Variations

1. horizontal line

2. Slash line

        - 3. Notes
        - 4. Bracket method
        - 5. Conversion table method
    - B. Conversions
        - 1. Dials, tapes
        - 2. conversion tables
    - C. Tolerances
    - D. Angle of projection
- XXV. Inspection and testing
    - A. Purpose
    - B. Destructive testing
    - C. Non-destructive testing
        - 1. Visual
        - 2. Ultrasonic
        - 3. Radiographic
        - 4. Magnetic particle
        - 5. Penetrant
        - 6. Eddy current
        - 7. Leak (hydrostatic)
        - 8. Proof
    - D. Non-destructive testing symbols
        - 1. Symbol
        - 2. Location
        - 3. Combinations
        - 4. Extent

XXVI. Geometric tolerancing

- A. Purpose
  - 1. Position
  - 2. Form
- B. Characteristics
  - 1. Symbols
  - 2. Modifiers
- C. Feature Control Symbol
- D. Reference to datum

COURSE NO. 421-352-

MODULE/UNIT NO. 1

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Understand the function and need for consistancy and drawings and the basic elements of orthographic projection.

LECTURE TIME 3

LABORATORY TIME 1

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Trace the use of blueprints from product design through production.	A list in sequence of people and operations involved in producing a sample fabrication.	Verbal check for understanding.
2. Explain the need for consistancy in the method of presenting information or blueprints.	Refer to list of people involved in preparation.	Students prepare a blueprint drawing of a simple fabrication.
3. Demonstrate the basic views, allignment and orientation of orthographic projection.	Use fold out models, line presentation and work sheet.	Unit Review questions
4. Describe the basic lines of orthographic drawings.	Draw on chalk board & describe basic lines, locate on sample drawings.	
	Read prefex and Chptr 1 of text book.	
	Show Video I Calculate high & low limits of fractional decimal and metric dimensions.	

COURSE NO. 421-352-

MODULE/UNIT NO. 2

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Develop skill in visualizing and drawing 3 dimensional shape from 2 dimensional orthographic drawings.

LECTURE TIME 1

LABORATORY TIME 2

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Demonstrate techniques for sketching left and right oblique and isometric pictorial drawings.	Read Unit 2 of textbook	Unit 2 Review
2. Help students to use those drawing skills to practice and gain skills in transforming 2 dimension orthographic drawings into 3 dimensional form and visa versa.	Produce isometric and oblique drawings on chalk board.	Verbal checks for understanding Semester Exam

COURSE NO. 421-352-

MODULE/UNIT NO. 3

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Locate and interpret all notes found on typical fabrication drawings.

LECTURE TIME 1/2 Hr.

LABORATORY TIME 1/2 Hr.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Show examples of general and specific notes and explain their application.	Read Unit 3 of textbook	Unit 3 review Verbal checks for understanding.
2. List and demonstrate information commonly shown in the specification block on sample drawings.	Differentiate between specific and general notes on sample drawings.	Student ability to locate specific and general notes on sample.

COURSE NO. 421-352-	NWTC INSTRUCTIONAL PLAN	Semester Exam INSTRUCTOR Carl Whitford
MODULE/UNIT NO. 4		DATE 6-7-91

LECTURE TIME 2

LABORATORY TIME 2

TERMINAL COMPETENCY: Use print dimensions to determine size and location layout, and process, arcs, radii, bevels, and holes using fractional decimal and metric dimensions and tolerances.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. State the two purposes of demonsions used on drawings.	Read Unit 4 Video II	Unit 4 Review
2. Show the correct methods of using fractional decimal and metric dimensions on drawings.	Prepare bills of materials from sample drawings.	Verbal checks for understanding.
3. Show procedures with all variations for dimensioning arcs and radii.	Demonstrate differences between baseline and conventional dimensioning on chalk board using fractional decimal and metric dimensions.	Accuracy in preparation of bills of materials.
4. Demonstrate the methods for dimensioning drilled holes.		Final Exam
	Demonstrate on chalk board methods for dimensioning bevels, arcs and radii.	

COURSE NO. 421-352-

MODULE/UNIT NO. 5

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

LECTURE TIME 3

LABORATORY TIME 1

TERMINAL COMPETENCY: Select and identify correct sheet, plate, bar pipe and structural materials from size specifications used on fabrication drawings.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Classify sheet and plate steel by thickness and gage.	Read unit #5	Unit 5 Review A, B, C, D, and E.
2. Compare thickness and shape of hot rolled and cold finished steels.	Demonstration of sample hot rolled and cold finished bar.	Verbal checks for understanding.
3. Outline the correct order of notation of size and weight specification for all structural shapes.	Use dimension specification tables. Use pipe schedule tables.	Competency in bill of material preparation.
4. Demonstrate the use of dimension specification table to determine dimensions and weights of beams and channels.	Prepare bill of materials stressing correct order of specification of structural forms.	Semester Exam.
5. Demonstrate the use of pipe schedule tables to determine outside diameter and wall thickness of pipe schedules.		
6. List common material abbreviations.		

COURSE NO. 421-352-

MODULE/UNIT NO. 6

* NWTC *
* INSTRUCTIONAL PLAN *

INSTRUCTOR Carl Whitford

DATE 6-7-91

LECTURE TIME 3

LABORATORY TIME 1

TERMINAL COMPETENCY: Utilize and interpret views and techniques commonly used by draftsman in addition to strict orthographic projection to give better detail and clarity.

SPECIFIC OBJECTIVES

1. Identify long and short brakes and revolved sections used with brakes and explanin their function or scaled drawings.
2. Draw auxiliary views from two dimensional drawings of objects with inclined surfaces and explain their function.
3. Show the alternate positions of the side views.
4. Illustrate the use of enlarged detail views.
5. State the formulas for calculating bend allowances and calculate and apply to preparation of developed views.
6. Trace revisions documanted in the revision block of sample drawings and determine revisions and results of these changes.
7. Demonstrate full and half section views.

LEARNING ACTIVITIES AND RESOURCES

Read Unit 6

Video III

Draw I beam w/brakes and revolved section on chalk board.

Draw incline surface with auxilary and side view on chalk board.

Show example drawings using enlarged details and alternate positions of side views.

Make calculations of sample formed plates.

Determine developed length, bond lines and prepare developed drawings.

Trace by date the revisions on a sample drawing and offer reasons for change.

Prepare full and half section views on chalk board and compare with front and side views.

EVALUATION METHODS

Unit 6 Review A, B, C, D and E.

Verbal checks for understanding.

Competency in calculating bend line and developed lengths.

Semester Exam

COURSE NO. 421-352-

MODULE/UNIT NO. 7

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Distingush between detail and assembly drawings coordinate detail drawings to the assembly drawing and reference detail drawings to obtain information not on assembly drawings.

LECTURE TIME 1/4 Hr.

LABORATORY TIME 3/4 Hr.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Compare sample assembly drawings that incorporate all details with assembly drawings that rely on separate detail drawings. Explain procedures for calculating specific detail information from both.	Read Unit 7 Use and compare assembly drawings with details inccluded and drawing with separate details.	Unit 7 Review A, B, C. Verbal quizing to check for understanding. Semester Test

COURSE NO. 421-352-

MODULE/UNIT NO. 8

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Identify common abbreviations and symbols and state their significance.

LECTURE TIME 1/4 Hr.

LABORATORY TIME

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. State the meaning and significance of abbreviations and symbols commonly used on fabrication drawings.	Read Unit 9 Discuss significance of this most commonly used symbols.	Verbal quizing to check for understanding Semester Exam

COURSE NO. 421-352-

MODULE/UNIT NO. 9

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Know the components of the standard welding symbol, all elements and symbols and the sifnificance of their location.

LECTURE TIME 2

LABORATORY TIME 1 3/4

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Identify the components of the standard welding symbol and explain the functions of each.	Read Unit 10 Video 4	Unit 10 Review A, B, Verbal quiz to check for understanding.
2. Show the significance of the location of the weld symbol by illustrating the area to be welded on the drawing.	Draw the line components of the welding symbol on chalk board. Explain elements and signifiance of location.	Semester Exam.
3. Identify the basic weld symbols and explain and illustrate shape and location of each.		
4. Identify supplementary weld symbol elements and explain location and significance of each.		
5. Draw the three contour symbols, demonstrate the significance of each and state the methods of applications and the symbols used to show application.		
6. Explain how the member to be beveled is distinguished on single bevel welds.		
7. Illustrate the definite locations on the welding symbol for designation of size or strength, length, pitch and number of welds.		
8. Identify the types of special information in the tail of the welding symbol.		

9. List the letter designations commonly used for welding, cutting, a finished processes and explain the meaning of each.

COURSE NO. 421-352-

MODULE/UNIT NO. 10

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Identify basic types of joints, types of preparation and welds applicable to each.

LECTURE TIME 3

LABORATORY TIME 1

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Identify the basic types of joints and the types of preparation applicable to each.	Read Unit 11	Unit 11 Review Summary review 2A, 2B.
2. Explain the necessary processing, fit-up and welding of simular and dissimular structural shapes.	Demonstrate the types of joints with plate and structural samples.	Verbal quiz for understanding.

Semester Test

COURSE NO. 421-352-

MODULE/UNIT NO. 11

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Correctly determine vertical and horizontal leg size weld length, and location for intermittant, multiple arrow and continuous fillet welds.

LECTURE TIME 2

LABORATORY TIME 2

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain the procedure for dimensioning vertical and horizontal legs of fillet welds on the welding symbol.	Read Unit 12 Video 5	Unit 12 Review A, B
2. Describe the method for layout of pitch and length of intermittent welds as specified on welding symbols.	Identify and label root, toe, leg, and throat of fillet welds and show how fillet size is designated on the welding symbol.	Students determine the number of welds in a given length of specified intermittent welds. Verbal quizing
3. Demonstrate how to compute the extent of weld by measuring the total inches of weld from fabrication drawings.	Demonstrate layout procedure for intermittent welds.	Semester Test

COURSE NO. 421-352-

MODULE/UNIT NO. 12

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

LECTURE TIME 2

LABORATORY TIME 2

TERMINAL COMPETENCY: Correctly determine groove weld preparation type, depth, included angle, depth of fill, root opening, back welding, and spacer material requirements from welding symbol information.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Show the location of groove weld depth of preparation, dimensions and included angle on the welding symbol and illustrate its signifance using cross sectional views.	Read Unit 13 Reproduce cross sectional drawings of preparation and welds specified in groove welding symbols.	Unit 13 Review A, B, C, D, Students competency in preparation welding symbols from information given in sentence notation.
2. Show the location of groove weld size dimensions on the welding symbol and illustrate it's significance.		Verbal quizing Semester Exam
3. Show location of groove weld root opening dimensions on the welding symbol and illustrate it's significance.		
4. Explain back gouging and it's application to groove welds.		
5. Explain the use of backing and spacer material and consumable inserts and show symbols and illustrate the application of each.		

COURSE NO. 421-352-
MODULE/UNIT NO. 13

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford
DATE 6-7-91

LECTURE TIME 2
LABORATORY TIME 2

TERMINAL COMPETENCY: Interpret welding symbols for melt thru, back, and backing welds and plug size slot welds to determine methods of preparation welding procedure, location, and extent.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Show the symbols for and explain the difference between melt-thru, back and backing welds and illustrate applications of each.	Read Unit 14 Read Unit 15	Unit 14 Review Unit 15 Review
2. Show the plug and slot weld symbol and illustrate how to determine location, size angle of countersink, depth of fill, number and pitch.	Use crossectional views of joints showing sequence of back and backing welds.	Verbal quiz for understanding. Semester Exam.

COURSE NO. 421-352-

MODULE/UNIT NO. 14

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Determine the length, width, height and direction of surface welds from surface welding symbols.

LECTURE TIME 1

LABORATORY TIME 1

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Draw surfacing welding symbols and show how length, width, height and direction are illustrated on drawing.	Read Unit 16 Visually show correct procedure to layout for surfacing per welding symbol and print details.	Unit 16 Review Verbal quizing to check for understanding. Semester Exam

COURSE NO. 421-352-

MODULE/UNIT NO. 15

NWTC INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Correctly interpret corner and edge welding symbols in the preparation and welding of fabrication member edges.

LECTURE TIME 1

LABORATORY TIME 1

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Show corner and edge flange welding symbols, illustrate how joints are prepared and dimensioned, explain their application.	Read Unit 17 Show crossection views of corner and edge flanges. Describe preparation procedure.	Unit 17 Review Verbal Quizing Semester Exam

COURSE NO. 421-352-

MODULE/UNIT NO. 16

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

LECTURE TIME 2

LABORATORY TIME 2

TERMINAL COMPETENCY: Interpret spot welding, projection welding and seam welding symbols and elements to correctly determine spacing, location, extent and strength.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Show spot welding symbols and demonstrate how dimension size, shear strength, spacing, location and extent and illustrated.	Read Unit 18 Read Unit 19	Unit 18 Review Unit 19 Review
2. Show projection welding symbols and illustrate embossment preparation application and it's elements.	Read Unit 20 Illustrate the meaning of the elements of spot, projection and seam welding symbols.	Unit 20 Review Verbal quizing Semester Exam
3. Show seam weld symbols and demonstrate how weld size, strength, length, pitch and orientation is illustrated in the symbol drawing details.		

COURSE NO. 421-352-

MODULE/UNIT NO. 17

* NWTC *
* INSTRUCTIONAL PLAN *

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Determine stud welding weld size, pitch, number and location from welding symbol and drawing details.

LECTURE TIME 1/2

LABORATORY TIME 1/2

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Show stud welding symbols and demonstrate how weld size, pitch, number and location are determined.	Read Unit 21	Unit 21 Review
	Show shape and location of stud weld symbol and examples of dimensioning elements.	Verbal Quizing
		Semester exam

COURSE NO. 421-352-

MODULE/UNIT NO. 18

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Accurately interpret all standard welding symbols supplementary symbols and location significance.

LECTURE TIME 1 1/2

LABORATORY TIME 1 1/2

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Present a comprehensive summary and review of welding, symbol elements, symbols, location significance, and references.	Read Unit 22	Summary Review 3A, 3B,
	Review of symbols, elements refermances.	Verbal quizing for understanding.
	Interpretation of welding symbols on sample drawings.	
	Question and answer session.	

COURSE NO. 421-352-

MODULE/UNIT NO. 19

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Correctly interpret single and double line pipe drawing symbols as they vary between companies to determine layout preparation and method of pipe joint connections.

LECTURE TIME 2

LABORATORY TIME 2

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Show standard ASME fitting and valve symbols for pipe fabrications and explain application.	Read Unit 23 Chart of ASME fitting and value symbols.	Unit 23 Review Verbal Quizing
2. Show examples of single and double line pipe symbols developed by various companies.	Examples of single and double line pipe drawings and pictorial drawings.	Semester Exam
3. Show the ways of illustrating the methods of connecting pipe joints from examples.		
4. Explain the correct methods of preparation and welding of pipe joints.		
5. Demonstrate the correct dimensioning practices of pipe layouts.		
6. Show examples of pipe layouts using both orthographic projection and pictorial drawing methods.		

COURSE NO. 421-352-

MODULE/UNIT NO. 20

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

LECTURE TIME 3

LABORATORY TIME 1

TERMINAL COMPETENCY: Be familiar with base units, supplementary units, derived units and metric prefixes and accuretly convert metric linear dimensions to decimal inches.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and compare the structure of the metric system.	Read Unit 24	Unit 24 Review A, B
2. List the seven Base Units and the two supplementary units of the metric system by symbol, name and quantity represented.	Make calculations of derived units.	Competency in calculating derived units.
3. Calculate derived units commonly used in metal fabrication, stating the mathematical processes, name and symbol of the derived units and the quantity represented.	Make conversions using conversion factor.	Competency in converting metric dimensions to decimal inches.
4. List the metric prefixes and the decimal numeration of each.	Show examples of drawings using metric dimensioning.	Verbal check for understanding.
5. Illustrate the elements of iso-inch and iso-metric screw and pipe thread designations.		Final exam.
6. Perform liear, area and volume calculations using metric conversion constants.		
7. Demonstrate correct and incorrect practices for presenting metric expressions and dimensions.		

COURSE NO. 421-352-

MODULE/UNIT NO. 21

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Develop skill in using drawings incorporating dual dimensioning with all variations of positioning methods.

LECTURE TIME 1

LABORATORY TIME 3

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Illustrate variations of the positioning and arrangement of dual dimensioning on drawings. 2. Compare symbols and drawing orientation of first and third angle projection.	Read Unit 25 Show examples of dual dimension drawings using various positioning methods.	Unit 25 Review A, B, C, D, E Verbal checking for understanding. Final Exam

COURSE NO. 421-352-

MODULE/UNIT NO. 22

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

LECTURE TIME 1

LABORATORY TIME 1

TERMINAL COMPETENCY: Know the common testing symbols, application location and extent as indicated on fabrication drawings and metallurgical properties tested.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain the common destructive testing practices and the various metallurgical properties tested by each.	Read Unit 26	Unit 26 Review
	Lecture on testing equipment and procedures.	Verbal quizing
2. Explain the common non-destructive testing symbols, application, location and the extent as indicated by welding symbols and drawing details.		Final Exam
3. Explain how common non-destructive methods are performed, equipment used, accuracy and metallurgical properties tested.		

COURSE NO. 421-352-

MODULE/UNIT NO. 23

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE 6-7-91

TERMINAL COMPETENCY: Understand the purpose of application of geometric tolerancing, identify geometric charactoristics a nd modifiers and correctely use feature control symbols.

LECTURE TIME 3

LABORATORY TIME 1

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Trace history of geometric dimensioning and tolerancing and explain its place in good drawing practice.	Read Geomotric Tolerancing handout Illustrates form and position toleranced by geomotric characteratics.	Semester Test Verbal Quizing.
2. Explain the purpose of geometric tolerancing and list the cases where it should be used to supplement conventional dimensionsing.	Interpret feature control symbols as used on sample drawings.	
3. List and identify the geometric characteristics.		
4. Illustrate the meaning and use of symbols and modifiers.		
5. Combine symbols, modifiers tolerance and datum reference to produce the feature control symbol.		
6. Demonstrate correct use and interpretation of the feature control symbol.		

APPLIED LAYOUT TECH 1

COURSE SYLLABUS

I. SUMMARY STATEMENT

Metal Fabrication
Applied Layout Tech 1
457-315- 2 Credit Hours

Office Location:
Telephone Number: (414) 743-2207
Advising time:

This course includes theory and hands on shop training the the production of Metal Fabrication processing templates, calculations for kerf allowance, developed lengths, material requirements and product design.

Synopsis Of Course

A. Contents of the course:

This course is the first of two semesters of the layout in the Metal Fabrication Program. The student will learn the purposes of kerf allowances, incorporation of nesting procedures, bend line and developed length calculations, basics of parallel line development and product design considerations.

B. Methods to be employed:

Method used in this course is a combination of lecture, practical lab in conjunction with metal fabrication lab and field experiences. Use of the overhead projector, videos, slide/tape presentations and transparencies are used throught the course.

C. Building Space and Equipment required:

Classroom space will be adjacent to a fabrication lab. The fabrication lab will be used for layout lab work.

D. Personnel Needed:

Personnel required for course is one instructor for both classroom lectures and supervising the lab sessions.

II. Rationale For the Course

This course is designed to be taken simultaneously with Metal Fabrication I and Industrial Math I. Course work parallels lecture and lab work performed in Metal Fabrication I. The course will direct students in techniques, procedure and production of processing templates and simple fabrication layouts and design to be used during Metal Fabrication lab work. Students will utilize math skills taught in Industrial Math I as well as subjects covered in Metal Fabrication I as a primary background for work performed in Applied Layout I.

III. Course objectives

1. The student will understand the purposes and uses of fabrication templates and utilize basic template marking tools and materials to produce rectangular angular and interior and exterior shaped templates from detail and assembly drawings.
2. The student will understand the purpose and importance of nesting and utilize good nesting practices and correct kerf allowances to nest templates with minimum material drop.
3. The student will calculate bend lines and developed lengths to produce forming and rolling layout and radius templates to detail and assembly drawing print specifications.
4. The student will gain knowledge of design and cost estimating considerations and use these to design sheet metal fabrications for fabricating assignment in metal fabrication lab and calculate fabrication costs.
5. The student will use parallel line development to produce sheet metal layouts and pipe layout templates.
6. The student will utilize patterns, template and layouts prepared during layout class in projects produced during fabrication lab and evaluate and modify these for accuracy and completeness of information.

Classroom Policy

1. No eating, drinking in the classroom - no smoking anywhere in the school.
2. No horse play in the classroom or inside and outside the labs.
3. No student will be allowed to work in the labs who is under the influence of alcohol or other drugs.
4. Any disruptive behavior is grounds for removal from the class.
5. All safety rules will be emphasized and followed throughout, the course.

Attendance Policy

Due to the nature and structure of this course, class attendance is of the upmost importance to the successful completion of this course. Attendance will be recorded daily and will become a part of your permanent record. If the student's progress is being hampored due to absences, a referral shall be made to the appropriate student services counselor.

Grading Scale

The following grading scale will be used to numerically determine the student's grade for the course:

A = 93 - 100
B = 85 = 92
C = 77 - 84
D = 70 - 76
F = 0 - 69 (Failing)

Computing Grades

Grades will be figured by adding test points, lab points, and quiz points together and dividing the total possible. The percentage will fall within the scale above.

Total grade determined by the following:

Major Test -)Points will be given for attendance
Quizzes -)and each category listed on left
Lab & Field -)The total number of points will make up 90% of the final grade.
Participation -)10%

Major Tests:

These tests may be made up within 10 school days, but they may not be the same tests.

Quizzes:

Quizzes must be made up within (5) school days or they will be recorded as a zero.

STUDENTS ARE RESPONSIBLE TO MAKE UP TESTS

Labs & Field Work:

Labs are considered as the major part of the class and all students are expected to participate. Labs will not be completed untill all material, tools and equipment has been stored properly and work area cleaned up. Students will not be allowed to leave until formally dismissed by the instructor. An early leave counts as an absence for the day. Students will be graded on initiative, communications, cooperativeness, crew integrity and positive attitude.

Text Required:

1. Metal Fabrication A Practical Guide
2. Metalwork Technology and Practice

Student Material List

1. Tool Box
2. Loose leaf note books & Paper (3ring holder)
3. Pens and pencils
4. Hard toe safety shoes
5. Hard hat
6. Safety glasses w/side shields
7. Gloves
8. Work clothing
9. Combination square

10. Steel punch
11. 12' Steel tape
12. Ball peen hammer
13. Scientific calculator

Job Opportunities

1. Sheet Metal industries
2. Structural steel construction and products
3. Plate Fabrication Products
    a. Construction equipment
    b. Military equipment
    c. Handling equipment
    d. Manfucturing equipment
4. Metal Fabrication Job shops
5. Pipe Fabrication
6. Pressure Vessel Fabrication
7. Ship building industry

Best Students Get The Best Jobs

No guarantee of a job when you graduate
Depends on you
We cannot get you the job

Willingness To Re-locatd For a Job

Don't limit yourself to this area

NWTC - Employment Assistance Center

Main Objectives:

To obtain marketable skills so that you can get a job. You will get out what you put into the class.

Input From Students Encouraged:

Ask questions. We want participation from the students.

COURSE NUMBER 457-315-
COURSE TITLE Applied Layout Tech 1

STUDENT TEXTS:

Title:	Metal Fabrication A Practical Guide
Authors:	Robert L O'Con, Richard H. Carr
Publisher:	Prentice-Hall Inc., Englewood Cliffs NJ 07632

Date Adopted: 1991 Copyright Date 1985

Title:	Metalwork Technology and Practice
Authors:	Victor E Repp, Willard J. McCarthy
Publisher:	Glencoe Publishing Company

Date Adopted 1991 Copyright Date 1989
Edition 8th

References:
Weldment Distoration - AWS
Pacific Press and Shape Comparr/Corporation and Maintainence Manual
Practical Sheet Metal Layout
Metals Hand Book - Vol 1-10

"A Treatise on Geometric Dimensioning and Tolerancing" by Lowell W Fister, Honeywell Inc.

Visual Aids:
Transparencies taken from above references
Various related videos and slide/tape presentations

Special Equipment and Supplies:
Overhead transparency
Slide projector W/tape
Television and VCR
Screen

SYLLABUS FOR: Layout I

TEXT: Metal Fabrication A Practical Guide.
Metal Work Technology and Practice

DATES SESSION TOPICS & BEFORE-CLASS ASSIGNMENTS

Scheduled Actual CLASS SESSIONS:

Week #1

__________ ______

Purpose of layout
Floor plan layout

Assignment:
NWTC shop layout

Week #2

__________ ______

Purposes of Fabrication Templates
Template making

Read:
Chapter 7 Metal Fabrication pp 93 - 94

Assignment:
Produce rectangular and angular
Shaped templates

Week #3

__________ ______

Kerf allowances
Material drop
Nesting

Read:
Chapter 7 pp 82 - 85

Assignment:
Nest planning

Week #4 & 5

__________ ______

Template making - arcs
Nesting arced templates

Read:
Chapter 7 Metal Fabrication pp 91 - 92

Assignment:
Produce exterior radiused templates

Week # 6 & 7

Interior holes - Processing methods
Template making - interior shape and holes

Assignment:
   Produce templates with interior shapes and holes

Week #8 & 9

Bend line and developed length calculations
Forming layout templates
Radius templates

Assignment:
   Produce forming, rolling templates
   Mid semester exam

Week #10 & 11

Joint preparation layout
Bevels, J grooves
Structural members
Parallel line development - pipe raps
Layout corner, edge, lap and plug joints

Read:
   Metal fabrication pp 88 - 91
   Work sheet 10 - 1

Assignment:
   Joint layouts and templates
   Pipe rap templates

Week #12

Sheet Metal Design
Layout of rectangular and truncated shapes

Assignment:
   Tool Box design
   Tool box layout

-------- ------ Week #13, 14, 15

Product design considerations
Fabrication method - determination
Material and labor cost estimating

Read:
   Handout 13-1, 13-2

Assignment:
   Cost estimating of tool box fabrication

-------- ------ Week #16

Pipe layout templates

Assignment:
   Pipe layouts

-------- ------ Week #17

Industry tours

-------- ------ Week #18

Final Exam

COURSE NO. 457-315-
MODULE/UNIT NO. 1

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford
DATE

TERMINAL COMPETENCY: Understand the basic purpose of Metal Fabrication Layout and use basic tools to produce a shop floor plan.

LECTURE TIME 2
LABORATORY TIME 2

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Define and explain the purpose of layout in the Metal Fabrication Industry.	Lecture and discussion	Verbal quizzing
2. Explain the purpose and use of shop layout on floor plan drawings to help in planning the safe and efficient positioning of equipment in the shop.	Demonstration and supervision in measuring and scaling shop layout.	Mid Semester exam
3. Describe the factors that need to be considered in locating equipment in a given plant floor plan.	Assignment to draw a scaled NWTC Fabrication shop layout. Identify equipment by name.	Ability to accurately scale and do depict details of shop layout.
4. Explain and demonstrate the method of drawing an existing shop layout.		

COURSE NO. 457-315-

MODULE/UNIT NO. 2

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 2

LABORATORY TIME 2

TERMINAL COMPETENCY: Know the purposes and uses of fabrication templates and utilize basic template making tools and materials to produce simple rectangular and angular templates.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain the purpose and uses of fabrication templates.	Lecture and discussion	Verbal quizzing
2. Describe and demonstrate the materials tools and methods used to produce simple rectangular and angular shaped paper templates.	Read chapter 7 pp 93-94. Demonstration of procedure to produce simple angular templates on paper. Assignment to produce simple angular templates on paper from detail drawings.	Mid Semester Exam Ability to accurately produce templates.

COURSE NO. 457-315-

MODULE/UNIT NO. 3

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 2

LABORATORY TIME 6

TERMINAL COMPETENCY: Know the purpose and importance of nesting and use templates with correct kerf allowances and nest to minimize material drop.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and define Kerf and state approximate kerf allowances for various processing methods and material thickness.	Lecture and discussion. Read Chapter 7, pp 82 - 85	Verbal Quizzing Mid Semester Exam
2. Explain the importance of minimizing material waste.	Demonstration of procedure to nest templates on sheet,plate and bar stock.	Ability to nest templates to maximize material usages.
3. Explain and demonstrate the process of nesting templates to minimize material drop with allowances for Kerf.	Assignment to plan nests of various shapes on bar and plates to maximize material usages.	

COURSE NO. 457-315-

MODULE/UNIT NO. 4

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 2

LABORATORY TIME 6

TERMINAL COMPETENCY: Accurately produce templates with exterior radii and arcs from detail drawings using a variety of dimensioning methods and nest these templates on plate of specified width.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate the use of layout tools and processes used to draw and layout interior and exterior arcs.	Read Chapter 7 pp 91 - 92 Lecture and discussion	Verbal quizzing Mid Semester Exam
2. Describe and demonstrate various dimensioning methods for locating radii and all centers and arc length.	Demonstration in use of layout tools to produce arcs and radii. Demonstrate the different methods used to dimension arcs and radii and how to interpret for layout.	Ability to accurately produce par templates with arcs and nest on plate with minimum drop.
3. Explain and demonstrate how to nest templates with external shape on plate steel with consideration for variables of number of pieces required, standard plate widths, and burning equipment available.	Demonstrate nesting procedure of exterior shape templates. Assignment to produce templates with exterior radii and arcs from detail drawings and nest on plate of various specified widths.	

COURSE NO. 457-315-

MODULE/UNIT NO. 5

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

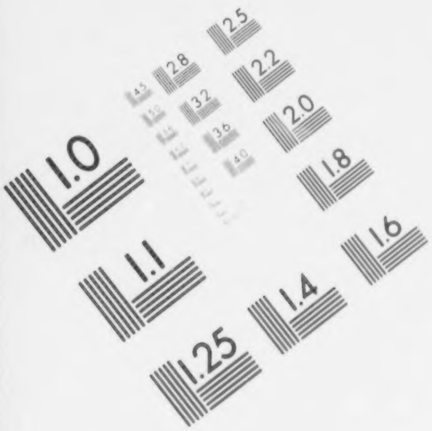
DATE

LECTURE TIME 2

LABORATORY TIME 6

TERMINAL COMPETENCY: Determine correct processing method to perform interior shapes and holes as specified by detail and assembly drawings and produce and use accurate layout templates for these operations.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and describe the conditions that would dictate when an inside diameter or shape can be burned to size.	Lecture and discussion Demonstration of layout of interior shapes on templates.	Verbal quizzing Mid Semester Exam
2. Explain conditions that would dictate that an interior diameter or slot must be drilled.	Demonstration of drill layout templates and precedure for marking work piece.	Ability to choose correct proces method and accuractely produce layout template for interior hol and shapes.
3. Explain and demonstrate how to locate centers and draw interior shapes for burn operations with pierce starts and Kerf allowance.	Assignment to deterine correct process method and prepare appropriate layout templates for interior holes and shape of specific items from detail and assembly drawings.	
4. Explain how to produce layout templates to locate centers and identify drill operations.		



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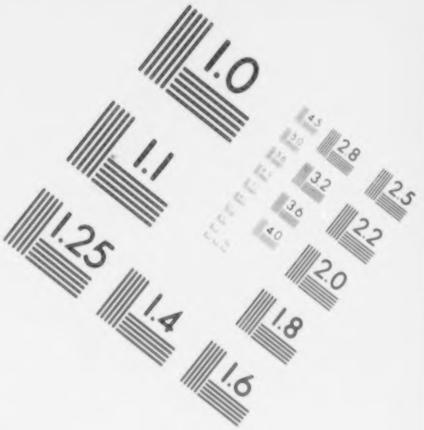

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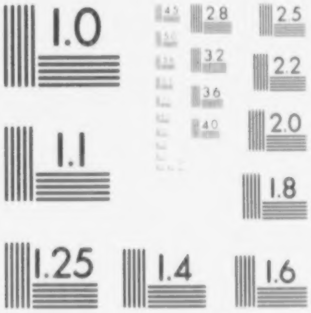
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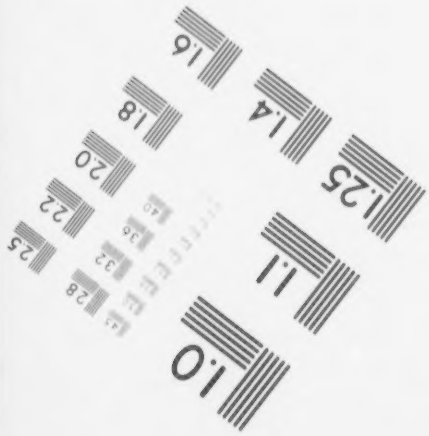

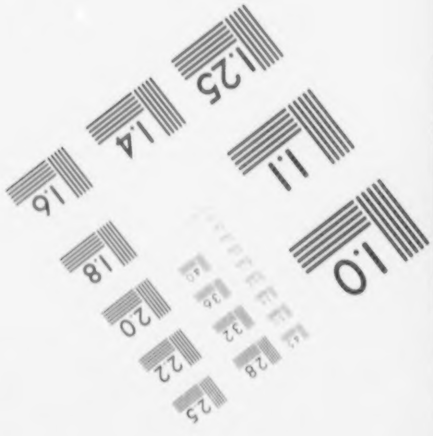

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COURSE NO. 457-315-

MODULE/UNIT NO. 6

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

TERMINAL COMPETENCY: Calculate bend lines and developed lengths and produce and use forming and rolling layout and radius templates to detail and assembly drawing print specifications.

LECTURE TIME 2

LABORATORY TIME 6

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate procedure to calculate bend line location and developed lengths for radiused plates of varing thickness.	Lecture and discussion Demonstration of calculations for and procedure to make and use forming and rolling templates.	Verbal quizzing Mid Semester exam Ability to produce and use formi and rolling layout and radius templates.
2. Explain and demonstrate procedure to make forming layout templates and mark work pieces.	Demonstration of procedure to produce and use radius templates for forming and rolling operations.	
3. Explain and demonstrate how to make and use radius templates for forming and rolling operations.	Assignment to produce and use forming and rolling layout and radius templates.	

COURSE NO. 457-315-

MODULE/UNIT NO. 7

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 2

LABORATORY TIME 6

TERMINAL COMPETENCY: Make accurate material allowances to process all joint methods and correctly layout and mark templates and work pieces for joint processing and set up.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate procedure to mark templates and layout work pieces for bevels and J grooves.	Lecture and discussion Demonstrations of calculating material allowances, template and work piece layouts for bevel, J grooves, pipe, tube, structural, flanges and plug joints.	Verbal quizzing Semester exam
2. Explain and demonstrate material allowance for root opening on process template and work piece layout.		Ability to accuractely make template and work piece layouts for all joint connections.
3. Explain and demonstrate work piece layout to join simular and dissimular sturctural members.	Assignment to make template and work piece layouts from drawings incorporating all variations of joint connections.	
4. Explain and demonstrate procedure of parallal line development to make pipe rap templates for layout of pipe joint preparation		
5. Explain and demonstrate method of calculating material allowances and layout for corner and lap joints.		
6. Explain and demonstrate methods to layout for plug and slot welds processing and work piece layout.		

COURSE NO. 457-315-

MODULE/UNIT NO. 8

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR

DATE

LECTURE TIME 1

LABORATORY TIME 3

TERMINAL COMPETENCY: Know design considerations and use these to design sheet metal fabrications and use parallel line development and knowledge of seam and hem preparation to accurately layout the sheet metal design.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate considerations and methods for design of sheet metal fabrications.	Lecture and discussion Demonstration of seam and hem design.	Verbal quizzing Semester exam
2. Explain layout of developed shape with seam and hem allowances for rectangular and truncated sheet metal fabrications.	Demonstration of procedure to layout rectangular and truncated sheet metal fabrication. Assignment to design and layout a tool box.	Ability to design functional tool box and layout the design for fabrication.

COURSE NO. 457-315-

MODULE/UNIT NO. 9

* NWTC *
* INSTRUCTIONAL PLAN *

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 4

LABORATORY TIME 8

TERMINAL COMPETENCY: Design, layout, determine production methods and cost of simple sheet metal fabrications, incorporating all product design considerations.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and describe product design considerations. a. Product reliability and durability. b. Product appearance and function. c. Minimize material costs. d. Minimize labor costs. e. Production equipment capabilities. f. Quantity of production lots.	Lecture and discussion Demonstrate how to calculate material and labor costs per unit on various lot sizes. Demonstrate how to design products using all design considerations.	Verbal quizzing Semester exam Ability to design a tool box, meeting all design considerations and accuratily calculating labor and material costs.
2. Explain and demonstrate how to calculate per unit material costs for various lot sizes.	Assignment to design a tool box, determine production method and determine per unit labor and material costs for production of various lot sizes.	
3. Explain and demonstrate how to calculate per unit labor costs for various lot sizes.		
4. Explain and demonstrate how to design products and determine fabrication methods by incorporating all design considerations.		

COURSE NO. 457-315-

MODULE/UNIT NO. 10

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

TERMINAL COMPETENCY: Skill in using parallel line development in producing pipe raps and pipe layout templates incorporating brakes and trim stock.

LECTURE TIME 1

LABORATORY TIME 3

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Review parallel line deveolopment process for producing pipe raps.	Lecture and discussion	Verbal quizzing
2. Explain and demonstrate procedure to layout pipe templates with brakes and trim stock.	Demonstration of procedure to make pipe templates.	Semester exam
	Assignment to produce pipe rap templates for common pipe schedules and pipe layout templates incorporating brakes and trim stock.	Ability to accurately produce pipe rapes and pipe layout templates.

NO[illegible]HEAST WISCONSIN TECHNICAL INSTITUTE

C[illegible]e Outline and Request for Course Approval / Adult & Continuing Education

REV 6/77

Prepared By	Date
Carl Whitford	7/26/91

Review/Revisions By

COURSE NUMBER 457-315-

COURSE TITLE Applied Layout Tech 1

D. P. TITLE

DIVISION T & I

PROGRAM ASSIGNMENT

SEM IN PROGRAM

PREREQUISITES

CREDIT BY EXAM ON FILE? No

(CHECK ONE)

- ☐ POST SECONDARY
- ☐ ADULT VOCATIONAL
- ☐ COMMUNITY SERVICE

Total Potential Hours of Instruction	72.00
Classroom Hours/Week	4.00
Lab Hours/Week	.
Shop Hours/Week	.
Clinical or Occupational Hours/Week	.
Field Experience Hours/Week	.
Total Student Hours/Week	.
Length of Course (Weeks)	18.00

AID CODE ☐☐

MATERIAL CODE ☐☐

CREDIT VALUE .

STATE APPROVAL DATE

COURSE TITLE & DESCRIPTION (Complete within this space)

This course includes theory and hands on shop training the production of Metal Fabrication processing templates, calculations for kerf allowance, developed lengths, material requirements and product design.

I. Layout Definition - process or manner of arrangement.

II. Purpose of layout in Metal Fabrication.

1. Planning.
2. Locating position.
3. Dimensioning size and shape.
4. Inspection.

III. Types of layouts

A. Floor plans, shop layouts.
  1. Purpose - determine where to place manufacturing equipment for maximum safety and efficency.
  2. Considerations.
    a. Space requirements
      (a) operator space
      (b) material movement and storage
    b. Material flow sequence
    c. Handling equipment
    d. Electric power
    e. Pheumatic power
    f. Ventilation
    g. Lighting
    h. Noise levels
  3. Method of drawing existing shop layout
    a. Tools and equipment required
      1. drawing paper
      2. pencils
      3. scaled rule
      4. 50 feet tapes
    b. Shop exterior wall layout
      1. Measure exterior wall dimensing
      2. Determine workable scale to transfer on drawing paper
      3. Produce scaled drawing
    c. Equipment Location
      1. Measure location of all equipment in relation to exterior walls.
      2. Use established scale to draw location on scaled layout
      3. Identify equipment by name
    d. Additional details
      1. Storage space
      2. Access doors, fire exits
      3. Handling equipment
      4. Electrical & pneumatic hook ups
      5. First aid stations
      6. Fire extinguishers

B. Dimensioning size and shape of fabrication piece parts.
  1. Marking cut line on work piece material for cutting guide.
    a. Straight angle

b. Template
c. Gauge
d. Pattern
e. Scribe
2. Template to control automatic burning equipment

C, Layout to locate placement of piece parts on assemblies
1. Marking location line on mating parts
2. Fixtures

D. Layout to locate drilling, machining, and interior cuts on piece parts and assemblies.

IV. Templates to determine size and shape
A. Template construction
1. Template materials
a. paper
b. mylar
c. wood
d. sheetmetal
2. Construction tools
a. Ink cartridge pens
b. Lead pencils
c. Exact knife
d. Straight edges
e. Scribes
f. Dividers
g. Trammel points
3. Production of templates with angular shape
a. Linear dimensions
b. Accuracy of protractors
4. Use of templates with angular shape
A. Kerf allowance
b. Nesting
c. Marking on work piece
5. Production of templates with exterior radii and arcs
a. Locating radii and arcs.
b. Angular dimensions
c. Chordal dimension
d. Multiple radii arcs
6. Nesting methods of exterior shape templates for sheet and plate steel.
a. Number of pieces required
b. Stock plate widths
c. Burning equipment available
7. Production of templates with interior radii and diameter
a. Burned holes
(1) Minimum diameter usually 2"
(2) Application, finish, tolerance or method specified may indicate holes must be drilled.
(3) Plate thickness variable of minimum burn hole size
(4) Pieces made on interior material of hole.
(5) Consideration for Kerf on interior cuts
b. Drilled Holes
(1) Template used to locate drill hole center line
(2) Marked on work piece with center bunch.
(3) Circle center punch on work piece and label drill size and requirements.

8. Producton of forming templates
    a. Calculating bend lines and developed lengths
        (1) Inside radius
        (2) Outside radius
        (3) Mean radius
        (4) Circumference calculations
    b. Developed length template formats
        (1) Locate bend line or tangent lines by punch marks
        (2) Indicate direction, degrees and radius of bends
        (3) If cross grain bending is required, indicate direction of grain flow.
        (4) Determine if forming stock is necessary, identify by punch marks and labels.
    c. Production of radius templates
        (1) Material
            a. Wood
            b. Metal
        (2) Use inside radius
        (3) Identify tangent lines

V. Joint preparation layout
    A. Mark joint process preparation method, location, size and extent on templates.
    B. Work pieces layout
        1. Bevels
        2. Grooves
    C. Layout for root openings
        1. Allowances on templates
        2. Layout for set up
    D. Structural steel work piece layouts
        1. I beam to I beam
        2. I beam to channel
        3. Channel to channel
        4. Channel to angle
        5. Angle to angle
    E. Joining tube and pipe
        1. Square and rectangular
        2. Round
            a. Pipe Rap templates
            b. Parallel lines deveopment of a tranacted cylinder
    F. Edge and Corner flange joints
        1. Material allowances for flange legs.
        2. Layout for processing of and set up of corner and flange joint).
    G. Plug, slot & lap joints
        1. Layout for processing of plugs and slots on work pieces and templates.
        2. Material allowances for lap joints

VI. Sheet Metal Fabrication

    A. Sheet Metal Design
        1. Seam Design
            a. Minimize welding
            b. Joint requirements
        2. Hem design
    B. Sheet Metal Layout
        1. Parallel line development

        - a. Square and rectangular
        - b. Truncated
    - 2. Seam and Hem layout
        - a. Rectangular pan
        - b. truncated

VII. Calculations for Fabrication Costs

- A. Material requirements
    - 1. Nesting
    - 2. Quantity
    - 3. Standard Sheet sizes
- B. Material pricing
    - 1. Material usage and Drop
    - 2. Material weight of quantity divided by units produced
    - 3. Material weight x price per pound
- C. Labor pricing
    - 1. Processing method
    - 2. Machine set up time
    - 3. Labor in tenths of an hour per piece

VIII. Product design considerations

- A. Minimum material costs.
- B. Minimize labor costs
- C. Production equipment available
- D. Product appearance and function
- E. Product availability & durability

METAL FABRICATION II

COURSE SYLLABUS

METAL FABRICATION II COURSE NO 457-321

I. SUMMARY STATEMENT

Metal Fabrication
Metal Fabrication II
457-321- 8 Credit Hours

Office Location:
Telephone Number: (414) 743-2207
Advising time:

This course includes theory and hands on training in fabrication methods and sequence; design, construction and use of fixtures, Use of table layouts; pipe and pressure fabrications; sheetmetal ducts and fittings; ship building; heat treating; combating distortion; weldment cleaning, touchup and finishing; and machine shop operations including laths, mills and precision grinding operations.

Synopsis Of Course

A. Contents of the course:

This course is the 2nd of two semesters in the Metal Fabrication Program. The student will incorporate math, blueprint reading, layout and processing skills from first semester training, plus training in heat treatment; fairing and straightening; cleaning, touch up and finishing; and machine shop. To produce a wide variety of complex metal fabrications.

B. Methods to be employed:

Method used in this course is a combination of lecture and practical lab and field experiences. Use of the overhead projector, videos, slide/tape presentations and transparencies are used throughout the course.

C. Building Space and Equipment required:

Classroom space will be adjacent to the lab (fabrication shop). Students will also use the adjacent welding lab for various assignments.

D. Personnel Needed:

Personnel required for course is one instructor for both classroom lectures and supervising the lab sessions.

II. Rationale For the Course

This course suceeds Metal Fabrication I and is a basic requirement in completing the program for a one-year vocational diploma. The course will build upon lecture and lab training from Metal Fabrication

I and Layout I. Students will continue to develop proficiency on processing equipment that they received training on during Semester I with concentration on developing proficiency in set up skills introduced in Semester I. Students will also be introduced to basic machine shop operations. All aspects of safety will be emphasized throughout the course.

III. Course objectives

1. The student will determine most efficient method and sequence of processing, set up and weld of complex metal fabrications.
2. The student will design, construct and utilize fixtures for appropriate metal fabrications.
3. The student will develop proficiency in performing pipe and pressure vessel layout, fitting and welding operations.
4. The student will develop proficiency in layout and fabrication of sheet metal round ducts and fittings, square to rounds, elbows, branches, tees and funnels.
5. The student will gain knowledge of fabrication skills and procedures required in the shipbuilding industry and relate shipbuilding skills and terminology to other metal fabrication procedures.
6. The student will acquire knowledge of heat treating equipment and processes and perform simple heat treat processes.
7. The student will understand the causes of weld distortion, predict potential areas of distortion, and utilize and evaluate methods to combat distortion in set up and weld operations.
8. The student will utilize fairing and straightening procedures to improve appearance and form of weldments and piece parts.
9. The student will develop proficiency in the ability to clean, grind and touch up a weldment and evaluate the work.
10. The student will correctly implement procedures to prepare material types and forms for application of protective or decorative coatings and recognize finishes and processes used for coating fabrication.
11. The student will know the principles of metal laths and perform simple lath set ups and operations.
12. The students will know the principles of mills and perform simple milling set ups and operations.
13. The student will incorporate math, blueprint reading, layout, processing, machine and set up skills to produce a wide variety of fabrications.

Classroom Policy

1. No eating, drinking in the classroom - no smoking anywhere in the school.
2. No horse play in the classroom or inside and outside the labs.
3. No student will be allowed to work in the labs who is under the influence of alcohol or other drugs.
4. Any disruptive behavior is grounds for removal from the class.
5. All safety rules will be emphasized and followed throughout, the course.

Attendance Policy

Due to the nature and structure of this course, class attendance is of the upmost importance to the successful completion of this course. Attendance will be recorded daily and will become a part of your permanent record. If the student's progress is being hampored due to absences, a referral shall be made to the appropriate student services counselor.

Grading Scale

The following grading scale will be used to numerically determine the student's grade for the course:

A = 93 - 100
B = 85 = 92
C = 77 - 84
D = 70 - 76
F = 0 - 69 (Failing)

Computing Grades

Grades will be figured by adding test points, lab points, and quiz points together and dividing the total possible. The percentage will fall within the scale above.

Total grade determined by the following:

Major Test -)Points will be given for attendance
Quizzes -)and each category listed on left
Lab & Field -)The total number of points will make up 90% of the final grade.
Participation -)10%

Major Tests:

These tests may be made up within 10 school days, but they may not be the same tests.

Quizzes:

Quizzes must be made up within (5) school days or they will be recorded as a zero.

STUDENTS ARE RESPONSIBLE TO MAKE UP TESTS

Labs & Field Work:

Labs are considered as the major part of the class and all students are expected to participate. Labs will not be completed untill all material, tools and equipment has been stored properly and work area cleaned up. Students will not be allowed to leave until formally dismissed by the instructor. An early leave counts as an absence for the day. Students will be graded on initiative, communications, cooperativeness, crew integrity and positive attitude.

Text Required:

1. Metal Fabrication A Practical Guide
2. Metalwork Technology and Practice

Student Material List

1. Tool Box
2. Loose leaf note books & Paper (3ring holder)
3. Pens and pencils
4. Hard toe safety shoes
5. Hard hat
6. Safety glasses w/side shields
7. Gloves
8. Work clothing
9. Combination square
10. Steel punch
11. 12' Steel tape
12. Ball peen hammer
13. Scientific calculator

Job Opportunities

1. Sheet Metal industries
2. Structural steel construction and products
3. Plate Fabrication Products
    a. Construction equipment
    b. Military equipment
    c. Handling equipment
    d. Manfucturing equipment
4. Metal Fabrication Job shops
5. Pipe Fabrication
6. Pressure Vessel Fabrication
7. Ship building industry

Best Students Get The Best Jobs

No guarantee of a job when you graduate
Depends on you
We cannot get you the job

Willingness To Re-locatd For a Job

Don't limit yourself to this area

NWTC - Employment Assistance Center

Main Objectives:

To obtain marketable skills so that you can get a job. You will get out what you put into the class.

Input From Students Encouraged:

Ask questions. We want participation from the students.

COURSE NUMBER 457-321-
COURSE TITLE Metal Fabrication II

STUDENT TEXTS:

Title: Metal Fabrication A Practical Guide
Authors: Robert L O'Con, Richard H. Carr
Publisher: Prentice-Hall Inc., Englewood Cliffs NJ 07632

Date Adopted: 1991 Copyright Date 1985

Title: Metalwork Technology and Practice
Authors: Victor E Repp, Willard J. McCarthy
Publisher: Glencoe Publishing Company
Date Adopted 1991 Copyright Date 1989
Edition 8th

References:
Weldment Distoration - AWS
Pacific Press and Shape Comparr/Corporation and Maintainence Manual
Practical Sheet Metal Layout
Metals Hand Book - Vol 1-10

"A Treatise on Geometric Dimensioning and Tolerancing" by Lowell W Fister, Honeywell Inc.

Visual Aids:
Transparencies taken from above references
Various related videos and slide/tape presentations

Special Equipment and Supplies:
Overhead transparency
Slide projector W/tape
Television and VCR
Screen

SYLLABUS FOR: Metal Fabrication II

TEXT:

DATES — SESSION — TOPICS & BEFORE-CLASS ASSIGNMENTS

Scheduled Actual CLASS SESSIONS:

Week #1

_________ ______

Method and Sequence
  1. Processing methods & sequence
  2. Set-up methods & sequence

Assignment:
Method and sequence

Week #2

_________ ______

Table Layouts
  1. Table layout procedures
  2. Table layout applications

Table layout procedures
Table layout applications

Assignment:
Table layout

Week #3

_________ ______

Fixtures
  1. Types and application
  2. Fabrication and use of fixtures

Assignment:
Fixture construction and use

Week #4 & 5

_________ ______

Pressure vessels
  1. Industry
  2. Joints, fittings, and heads
  3. Fabrication
  4. Inspection

Assignment:
Shell fabrication
Fabrication of heads & fittings

Week #6 & 7

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Sheetmetal Work
1. Sheetmetal Hand tools
2. Hand operated machinery
3. Power operated sheet metal equipment
4. Sheet metal fabrication

Read:
Chapter 16 Metal Fabrication pp 258 - 280
Part 8 Metal Work pp 258 - 280

Assignment:
Metal Work Review p 264, p 272,
Sheet Metal Fabrications

Week #8

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Nautical Fabrication
1. Hull Fabrication
2. Fitting hull with components

Shipyard tour

Assignment:
Shipyard and layout work sheet

Week #9

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Heat Treating
1. Heat treating procedure & equipment
2. Effect of carbon content
3. Heat treating processes

Read:
Unit 41 Metal Work pp 338 - 352
Chapter 22 Metal Fabrication pp 315 - 320

Assignment:
Heat treat work sheet

Week #10

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Welding distortion
1. Reason for distortion
2. Control of distortion

Read:
"Distortion" handout

Assignment:
Distortion work sheet

Week #11

Faring and straightening
1. Purpose and methods
2. Faring procedure
3. Straightening procedure

Assignment:
Faring and straightening work sheet

Week #12

Weldmont cleaning and touch up
1. Identificating defects
2. Equipment
3. Procedure

Assignment:
Touch up and cleaning assignments

Week #13

Finishing and coating
1. Surface preparation
2. Equipment and procedure

Machine shop orientation

Read:
Part 12 Metal Work pp 378 - 395

Assignment:
Finishing and coating assignment
Machine shop layout work sheet

Week #14

Laths
1. Principles
2. Mounting and centering
3. Cutting tools
4. Feed ratos
5. Operation

Read:
Part 16 Metal Work pp 450 - 497

Assignment:
Metalwork "Review" P 459, P 468,, P 476-7, P 480, P 483, P 487, P 490, P 492, P 493, P 497.

Lath operation assignments

Week #15

Mills length operation assignments

1. Principles
2. Controls
3. Safety
4. Holding devices
5. Milling cutters
6. Spoons & feeds
7. Operation

Read:
Part 17, Metal Work PP 498-529

Assignment:
Metal Work Review P 508, P 515, P 522,
P 526, P 529
Face milling assignment
Chamfer milling assignment

Week #16

Precision Grinding
Automation and numerical control

Read:
Part 19 Metal Work PP 548-565
Part 21 Metal Work PP 582-593

Assignment:
Metal Work Review P 553, P 555, P 560, P 565
P 587, P 594
Surface grinding assignment

Week #17 & 18

Individual fabrication project

1. Process
2. Set up
3. Weld
4. Inspection
5. Clean and touch up
6. Paint machine

Final exam

I. Determination of Processing Methods and Sequence

A. Considerations
  1. Quantity required
  2. Material type
  3. Plate thickness
  4. Width and length size
  5. Tolerance requirements
  6. Available processing equipment
  7. Machine burden costs
  8. Machine time availability
  9. Process equipment locations

B. Predetermined Routing
  1. Applications
    a. Method of production control
    b. Large scale fabricators
    c. Specialized processing personnel
    d. Departmentalized operations
  2. Preparation of Routing sheets
    a. Prepared by Engineering Department
    b. Information formate
      (1) Order number
      (2) Drawing number
      (3) Material type
      (4) Material blank size and weight
      (5) Each fabrication operation identified by method, equipment ID and in sequence of operation.
      (6) May show estimated fabricating time for each operation.
      (7) Scheduling of fabrication start and completion dates
  3. Set up employee use of routing sheets
    a. Trace operation sequence of individual piece parts to make sure no operations were missed prior to set up operation.
    b. Use to back track location of missing piece parts.
    c. Use to determine status of in process piece parts.
    d. Use to hold individual piece parts and sub assemblies in storage until all processing is complete for set up.
    e. Expeditors gather piece parts and bring to set up table when job is ready for set up.

C. Processing of piece parts as the responsibility of set up personnel.
  1. Types of fabricators
    a. Sheet metal shops
    b. Pipe shops
    c. Small job shops
    d. Prototype and model builders
  2. Operating procedure

- a. Obtain production orders
    - 1. Quantity
    - 2. Order number
    - 3. Specific instructions
- b. Study prints
- c. Obtain templates, patterns prepared
- d. Prepare templates wgeded
- e. Determine processing methods
- f. Determine sequence of processing
- g. Determine material required

II. Determination of set up and weld methods and sequence.

A. Pre-machining of piece parts.
- 1. Cost effectiveness
    - a. Burden rate
    - b. Handling
- 2. Necessity for accessibility
- 3. Considerations
    - a. Machine tolerance effected by weld distortion.
    - b. Machine tolerance must be held in position
    - c. May require locating fixtures

B. Fabrication Sub Assemblies
- 1. Necessity due to lack of accessibility for welding.
    - a. Interior welds with cover.
    - b. Continuous welds interrupted by other plate members.
- 2. To accommodate machine welding processes - sub-merged arc
- 3. For ease of positioning for weld operations
- 4. To accomodate sub assembly machining operations.

C. Procedure to determine set-up and weld method and sequence.
- 1. Determine operations to be performed from routing or instructions.
- 2. Study Blueprint.
    - a. Identify piece parts by item.
    - b. Read all notes, tolerance.
    - c. Check revisions
    - d. Check welding symbols and notes.
- 3. Locate and examine all piece parts for conformity.
    - a. Latest revisions.
    - b. All processing completed.
    - c. All dimensions within tolerance.
    - d. All edges clean from slag, burrs, square.
- 4. All piece parts must be located and ready for set-up before proceeding with set up.
- 5. Determine if table layout is helpful.
    - a. Number of fabrications.
    - b. Tolerance requirements.
    - c. Size.
    - d. Can fabrication be started from flat layout.
- 6. Can layout be made on one or more of the piece parts.
- 7. Set up pieces to establish squares, angles and shapes first.
- 8. Brace as necessary.
    - (a) Hold tolerances.
    - (b) Avoid weld distortion.

9. Check to make sure all components are complete and within tolerances.
10. Identify work piece by drawing number and fabricator ID.
11. Mark for welding locations and size.
12. Find center of gravity and mark for pick up and handling

III. Table Layouts

A. Review of table layout tools.
   1. Squaring tools.
      (a) Table edges
      (b) Machinists square
      (c) Combination square
      (d) Bevel square
      (e) Levels
      (f) Plumbs
      (g) Templates, paterns
      (h) Right angle triangles
         (1) Calculations
         (2) 3, 4, 5 Rule
   2. Straight Edges
      a. Table edge
      b. Steel rules
      c. Steel and Alluminum
      d. Lines and chalk lines
      e. Combination square
   3. Marking tools
      a. Soap stone
      b. Chalk line
      c. Felt Tip pens
      d. Die
      e. Dividers
      f. Tramel points
      g. Scribes
      h. Punches
   4. Measuring tools
      a. Steel tapes
      b. Steel rules
      c. Combination square
      d. Machinists squares
      e. Layouts tapes
   5. Leveling tools
      a. Transits
      b. Levels
      c. Plumb lines
   6. Angle determination
      a. Bevel square
      b. Trigometric angle legs

B. Auxiliary table layout equipment.
   1. Shims
   2. Parallels
   3. Stops, angles, clamps & wedges

C. Applications
   1. Not necessary if layout can be made on one or more major member peices.
   2. Major members must be capable of sitting on table

flat or with parallels or braces.
3. Stops and clamps help locate and hold major members.
4. Other piece part layouts can be located on tables and transferred to member parts with squaring and leveling tools.

IV. Use of Fixtures.

A. Applications
1. Locate for drill and machining operations.
2. In conjuction with pre-machined sub weldment and piece parts.
3. Holding close tolerances with consistancy.
4. Holds and locates members.
5. Illiminate need for layout and locating.
6. Combate weld distortion.

B. Types
1. Simple fabricator designed
  a. Base plates
  b. Stops to locate
  c. Clips and clamps to hold.
  d. Squaring and shape guides.
2. Complex engineer designed.
  a. Detailed fabrication drawings.
  b. Machined and milled to precise tolerances.
  c. Special clamping and bolting devises.
  d. Machined locating pins and bushings.
  e. May pivit for positioning of set up and weld.

C. Maintainance
1. Identification
2. Storage
3. Handling
4. Use
  a. Some designed for set up only.
  b. Weldmont can become seized in fixture if not designed properly or if welding is done in fixture.
  c. Set up must be securely braced before removing for welding.
  d. Must use caution to keep pins and machined surfaces free of weld spatter and burrs.
  e. Excessive force in obtaining fit or in removal can damage fixture.
  f. First piece inspection to check fixture accuracy.

V. Pipe and Pressure vessel fabrication.

A. Review of pressure vessel industry tour.
1. Product uses.
  a. Chemical
  b. Paper
  c. Manufacturing
  d. Food processing
2. Importance of Quality Control
  a. Product liability
  b. ASME certification
  c. Safety hazards

    3. Materials
        a. Stainless Steel
        b. Spun heads
        c. Fittings and flanges
        d. Fabricated shells
        e. Pipe and tube

B. Fabricated shells processing
    1. Rolled with one seam.
        a. Layout shell plate with correct layout template
        b. Obtain inside radius template.
        c. Shear shell to template layout.
        d. Process joint preparation.
        e. Form ends to tangent layout of radius template.
        f. Insert shell plate into pyramid rolls and roll to radius template.
    2. Formed in 2 sections.
        a. Layout shell plate sections with correct layout template and mark forming stock tangent.
        b. Shear shells to template layout.
        c. Form shells to inside radius template.
        d. Burn forming stock and joint preparation bevels with track burner.
        e. Shear backing bars.

C. Fabricated shell set up procedure.
    1. One seam.
        a. Study Blueprint.
        b. Inspect forming accuracy.
        c. Determine joint requirement.
        d. Inspect joint preparation.
        e. Obtain root opening spacers.
        f. Closing joint.
            1. Turn buckles.
            2. Pull jacks.
            3. Angles and clamps
            4. Angles and nuts and bolts.
        g. Leveling the seam
            1. Clips
            2. Wedges
    2. Two or more shell section set-up procedure.
        a. Study Blueprint.
        b. Inspect forming accuracy and joint preparation.
        c. Obtain one shell section and layout, fit and tack back up bars concave.
        d. Pick up 2nd half and move convex on to mate with 1st section.
        e. Locate and clamp one end and tack.
        f. Adjust overhead lift to approximate location opposite and clamp.
        g. Repeat for opposite seam.
        h. Continue fit and tack from 1st tack.
        i. Use clips and wedges to obtain tight fit on shell to back up bar.

D. Set up of end caps or heads and fittings.
    1. Shear and roll back up bars for shell ends.
    2. Check end caps or head diameter to mating ends of shell.

3. Fit and tack back up bars to end caps.

4. Layout and burn holes for all flanges and fittings in heads.
5. Fit, tack and weld fittings to heads.
6. Layout shell, process all burn holes.
7. Fit tack and weld all fittings in shell.
8. Clean interior of shell.
9. ASME inspecter must inspect all welds and clean out before heads fitted.
10. Locate to layouts and fit and tack heads to shell.
11. Welding of Heads
   a. On pipe rollers
   b. Often done with submurged arc process.

E. Testing and Inspection.
   1. In process inspection.
   2. Final.
      a. Hydrostatic testing
      b. Pressure testing.

VI. Sheet Metal Fabrications

A. Review of Sheet Metal Industry.
   1. Products
      a. Heating and air conditioning.
      b. Electrical panels and boxes.
      c. Heavy machinery cabs, housings.
   2. Job Description
      a. Often small shops within large product manufacturers
      b. Fabricators often perform all aspects.

B. Hand tools.
   1. Scratch awl
   2. Scribers.
   3. Hammers
      a. Setting
      b. Raising
      c. Riveting
      d. Mallot
   4. Punchs
      a. Chassis punch
      b. Hand
      c. Turrot
   5. Flat nose pliers
   6. Hand seamer
   7. Hand groover
   8. Tin snips - 20 gage or thinner
      a. Aviation
         (1) Left
         (2) Right
         (3) Straight
      b. Double cutting
      c. Hawk's Bill
   9. Files
   10. Hack Saws
   11. Chizels

C. Hand Operated machinery

1. Manually operated squaring shear.
2. Notcher
3. Ring and circle shear.
4. Lever shear.
5. Electric nibblers.
6. Portable electric shears.
7. Bar folder.
8. Cornice Brake.
9. Box and pan brake.
10. Slip-roll forming machines.
11. Turning machine.
12. Wiring machine.
13. Burring machine.
14. Setting down machine.
15. Crimping and beading machine.
16. Grooving machine.
17. Stakes.

D. Power Equipment
   1. Pittsburgh Lock Forming Machine.
   2. Press Brake.
   3. Iron worker.
   4. Rolls

E. Press working processes
   1. Shearing
      a. Punching
         (1) Punch and die types
         (2) Die clearance
         (3) Punch and die installation
         (4) Punch stripping Devices
         (5) Punching set ups
         (6) Set up variations
      b. Blanking
      c. Perforating
      d. Lancing
      e. Shaving
   2. Bending
      a. Angle bending
      b. Curvilinear bending
      c. Beading
   3. Drawing
      a. Shell drawing
      b. Embossing
      c. Stretch forming
   4. Squeezing
      a. Coining
      b. Burnishing

F. Fabrication of Round ells.
   1. 90 Degree ells
      a. 2 piece 45 degree seams.
      b. 3 piece 22 1/2 degree seams.
   2. 45 degree ells
   3. 30 degree ells

G. Fabrication of tees
   1. 90 degrees tees
   2. 45 degree tees

3. 30 degree tees

- H. Fabrication of pyramids
  - 1. Square
  - 2. Rectangular

- I. Fabrication of cones

- J. Fabrication of square to round transitions

VII. Nautical Fabrication

- A. The Nautical Industry.
  - 1. Pleasure craft
  - 2. Navy and Coast Guard
  - 3. Greal Lakes shipping
  - 4. Ocean going

- B. Construction Materials review
  - 1. Steel and alloy
  - 2. Alluminum
  - 3. Stainless components
  - 4. Wood

- C. Types of fabrications reviewed
  - 1. Large heavy plate
  - 2. Sheet Metal
  - 3. Small foundations
  - 4. Pipe
  - 5. Structural steel

- D. Ship Hull Fabrication
  - 1. Materials
    - a. Steel
    - b. Alluminum
    - c. Wood
  - 2. Nautical nomenclature
    - a. Nautical drawings
      - 1. Front view - profile
        - a. Port
        - b. Starboard
      - 2. Side views
        - a. Stearn
        - b. Bow
      - 3. Sections - Frame lines
      - 4. Topview - plan
    - b. Hull components
      - 1. Keel
      - 2. Frames
      - 3. Bulk heads
      - 4. Shell plate
      - 5. Decks
      - 6. Deck housing
  - 3. Fabrication methods
    - a. Large ships 600 - 1000 ft.
      - 1. Hulls built in sections
        - a. port side
        - b. starboard side
      - 2. Sections located on keel set on dock launch site.

      b. Smaller ships & pleasure craft
         1. All frames set on keel
         2. Decks and shell plate fitted to located frames and bulkheads.
   4. Hull launching
      a. Dock side
      b. Dry dock

E. Fitting hull with components
   1. Piping
   2. Electric panels, boxes
   3. Foundations, mechanical & electrical
   4. Cabinets & housings
   5. Machined components

VIII. Heat Treating

A. General Procedures
   1. Heat metal to a certain temperature
   2. Holding at this elevated temperature (soaking)
   3. Cooling metal at a certain rate

B. Principal Processes
   1. Hardening
   2. Tempering
   3. Annealing
   4. Normalizing
   5. Spheriodizing
   6. Case Hardening
   7. Flame hardening
   8. Induction hardening

C. Furnaces and Temperature Control
   1. Kinds of furnaces
      a. Electric
      b. Gas fired heat treatment
      c. Gas fired pot-type liquid hardening
   2. Temperature control thermostate
   3. Temperature colors
   4. Temperature indicating material
      a. Pellets
      b. Crayons
      c. Liquid

D. Effect of Carbon Content on Hardening
   1. High carbon steel 0.60 % to 1.5% carbon
      a. Hard Brittle
      b. Used for tools - drills, cutters, taps
   2. Medium Carbon 0.30% to 0.60% carbon
      a. Medium hard
      b. Uses - rods, axles, hammers
   3. Low Carbon
      a. Little direct hardening
      b. Outside case hardening

E. Process of altering hardness
   1. Annealing
      a. Makes steel soft for machining and forming.

- b. Removes internal stresses from working and welding.
- c. Method
  - (1) Heat to 1500 - 1600 degree (Cherry Red)
  - (2) Cool slowly (several hours)

2. Hardening
   - a. Heat to 1500 - 1600 degrees (Cherry Red)
   - b. Quench rapidly
     - (1) Room temperature water - may cause cracking
     - (2) Room temperature oil
     - (3) Move vigorously in circular motion
     - (4) Keep work piece completely submerged
3. Flame Hardening
   - a. Larger pieces
   - b. Hardens surface rather than entire crosssection
   - c. Heat surface with torch.
   - d. Quench with water hose.
4. Tempering
   - a. Remove stresses of fully hardened steel.
   - b. Increase strength and ductility
   - c. Alters hardness to lesser degrees.
   - d. The higher the temperature the softer the steel becomes.
   - e. Process
     - (1) Must first be fully hardened.
     - (2) Area to be tempered must be sanded to bright shinny finish.
     - (3) Heat to desired color.
     - (4) Quench in oil.
5. Case hardening
   - a. Surface harden thin outer layer.
   - b. Inner core remains soft.
   - c. Suitable for low carbon steel.
   - d. Adds carbon to metal surface.
     - (1) Use of carburizing agent.
     - (2) Kasenite.
   - e. Procedure
     - (1) Wear tinted safety glasses.
     - (2) Heat work piece to 1650 degrees (cherry red).
     - (3) Dip and roll into Kasenite powder.
     - (4) Reheat part to dull red.
     - (5) Repeat stops 2 and 3.
     - (6) Quench work piece radidly in cold water.
     - (7) Work in well ventilated area.
   - f. Alternative Process
     - 1. Heat work piece to cherry red.
     - 2. Shut off oxygen use pure acetylene to produce heavy carbon soot.
     - 3. Turn oxygen back on, reheat to cherry red.
     - 4. Repeat stops 2 & 3 three more times.
     - 5. Quench in cold water.
6. Hardsurfacing
   - a. Layer surface with weld.
   - b. Increases corrosion, wear and impact resistance.
   - c. Uses any manual welding process.
   - d. Filler material
     - 1. ferrous based alloys (nickel, chromium, moylbdenum, manganese)
     - 2. Tungsten
     - 3. Tungsten Cobalt

        4. Copper alloy

IX. Distortion

- A. Reasons for distortion
  - 1. Changes in properties of steel with increases in temperature.
    - a. Thermal expansion
    - b. Electricity
    - c. Yield strength
    - d. Thermal conductivity
  - 2. How Metal properties of metals effect distortion.
    - a. Low conductivity
      - (1) Steep temperature gradient.
      - (2) Increased shrinkage
    - b. High yield strength
      - 1. After shrinkage stress is at or near yield strength.
      - 2. Higher yield strength the higher the stress that distorts.
      - 3. Minimize by welding in annealed condition.
    - c. Low modulese of elasticity
      - 1. Stiffness measure
      - 2. More stiffness gives more resistance to distortion.
    - d. High coeficient of thermal expansion
      - 1. Amount of expansion at welding heat.
      - 2. Greater expansion, greater distortion.

- B. Types of distortion
  - 1. Transverse shrinkage.
    - a. Butt and bevel welds
    - b. Fillet welds
    - c. Welds on neutral axis.
    - d. Welds above or below neutral axis
  - 2. Angular distortion
    - a. Butt and bevel welds
    - b. Fillet welds
    - c. Welds on neutral axis
    - d. Welds above or below neutral axis
  - 3. Longitudinal shrink age
    - a. Butt and bevel welds
    - b. Fillet welds
    - c. Welds on neutral axis
    - d. Welds above or below neutral axis

- C. Shrinkage Control
  - 1. Do not overweld
    - a. Tight fit up and joint preparation
    - b. Correct weld size
    - c. Joint design
  - 2. Use intermittent welding
    - a. Correct layout of pitch and length
    - b. Design
  - 3. Use as few passes as possible
    - a. Larger electrodes
    - b. Higher wire feed rates
  - 4. Place welds near neutral axis
    - a. Minimize leverage
    - b. Design function
  - 5. Balance welds around neutral axis

a. Offset one shrinkage force with another
b. Weld sequence, positioning

6. Use back step welding
   a. Most effective on first pass
   b. Progression opposite of direction of deposition
7. Anticipate shrinkage forces
   a. Pre-setting out of position
   b. Pre banding, pre-springing
   c. Identical weldmonts back to back
   d. Restraints
      1. Fixtures
      2. Jigs
      3. Clamps
      4. Braces
      5. Strong backs
8. Plan the welding sequence
   a. Intermittent welds
   b. Butt welds
   c. Neutral axis
   d. Repositioning weldmont
   e. Repositioning body

X. A. Straightening

A. Purposes
  1. Cosmetic appearance - illiminate waveness
  2. To maintain dimension al tolerances - srink stretched material.
  3. Aid in obtaining fits and locations.

B. Methods - shrink tight fits, secure with shrink fits
  1. Faring
    a. Heating cherry rod 1500 - 1600 degrees
    b. Upset with hammer and backup.
    c. Rapid cooling - water
  2. Press Brakes
  3. Jacks, Porta Powers, clamps

C. Farring equipment
  1. Heating
    a. Aceylene torch not requiring oxygen trigger
    b. Heating tips - dispurse heat <one
  2. Up set equipment
    a. Hammer
    b. Mallets
  3. Cooling water
    a. 5 Gallon can
    b. Compressed air
    c. Trigger spray gun

D. Fairing procedure
  1. Locate specific areas that are stretched and layout heat and shrink areas.
  2. Heat an area approximately 3 inches in diameter with spiral motion of heating tip to cherry red color.
  3. While concave side of heated area is supported with a flat mallet strike convex side with hammer and malet.
  4. Immediately spray heated area with cooling water.
  5. Move outward from 1st shrink and continue process until work piece is at desired straightness.

E. Consideration in using fairing procedure
  1. Changes metallurgical properties
    a. Case hardens low carbon steel
    b. Hardens high carbon steels
  2. Difficulty in anticipating expansion and shrink forces.

F. Straightening in Press Brake
  1. Size of work piece limited to die opening and press stroke and tonage capacity.
  2. Difficult to anticipate spring back of work piece under stress.
  3. Process designed for specialized straightening.

G. Jacks, porta powers, clamps and wedges.
  1. Procedure to stretch material in areas that have shrinkage from distortion.
  2. Can apply locally on large fabrications.
  3. May use heat to improve ductility but must allow to cool slowly to avoid shrinkage.

XI. Weldment cleaning, grinding and touch up

- A. Purposes
  - 1. Remove slag
  - 2. Remove weld spatter
  - 3. Remove weld strikes
  - 4. Blend weld starts
  - 5. Blend under cut
  - 6. Blend roppy welds
  - 7. Repair all weld defects
  - 8. Repair under size welds
  - 9. Grind required weld finish
  - 10. Radius shape edges
  - 11. Remove mill scale, surface defects, rust and oil
- B. Equipment
  - 1. Shot blast
  - 2. Sand blast
  - 3. Acid pickling
  - 4. Disc grinders
  - 5. Cup and cone grinders
  - 6. Die grinders
  - 7. Metal files
  - 8. Slag hammer
  - 9. Chipping and peaning hammers
- C. Procedure heavy plate fabrications
  - 1. All fabrication and welding operations must be complete
  - 2. All heat treating must be completed
  - 3. All straightening must be completed
  - 4. Sand or shot blast
    - a. Tape all threated and machine surfaces
    - b. Avoid blast prior to heat treating

      Touch up to visually reveal defects remove much spatter
  - 5. Check for undersize welds, undercut, defects roppy welds
  - 6. Use combinations of disc, cone, pencil and file grinding tools to improve weld appearance
  - 7. Touch up welding with small rod hand arc ok when heat will not distort and no machinering performed.
  - 8. Tig weld touch up when distortion could be a problem
  - 9. Do not do any welding or heating on weldmonts with machining without instructions from supervisor.
  - 10. Radius shape edges
  - 11. Blend touchup
  - 12. Clean all spatter
- D. Procedure stainless and alluminum
  - 1. Pickle
    - a. Common to pickle sheet and plate prior to fabrication to remove oil protective coatings.
    - b. May be used prior to paint to remove any oils from process operation.
  - 2. Shot blast - too abrasive to be used on alluminum
  - 3. Touch - up principles similar to plate steel

XII. Metal finishing and coatings

- A. Coating purposes
  - 1. Appearance
    - a. Cosmetic
    - b. Trade mark colors
    - c. Safety - Visability
      - (1) Fire trucks
      - (2) Road construction
      - (3) Protruding fabrication on equipment
  - 2. Improve work and finish
    - a. Plating
    - b. Chadding
  - 3. Corrosion protection
    - a. Materials that resists corrosion
    - b. Weathering steel - cor-ten
    - c. Protective coatings
- B. Surface preparation
  - 1. Grinding
  - 2. Wire bushing
  - 3. Filing
  - 4. Abrasive polishing
  - 5. Blasting
  - 6. Pickling
  - 7. Brushing & wiping
  - 8. Degreasive solvents
- C. Metal Coatings
  - 1. Chemical conversion coatings
  - 2. Chromate coatings
  - 3. Phosphate coatings
  - 4. Blank oxide coatings
- D. Painted finishes
  - 1. Primer
    - a. Red Lead
    - b. Zinc chromates
  - 2. Enamel
    - a. Brushing
    - b. Spraying
    - c. Dipping
    - d. Baked
  - 3. Lacquer
    - a. Brushing
    - b. Spraying
    - c. Very flammable
    - d. Special solvent for thinning & cleaning
- E. Brush painting procedure
  - 1. Move brush evenly
  - 2. Brush marks flow in longest dimension
  - 3. Finish by wiping excess material from brush and lightly stroke surface.
- F. Hand spraying
  - 1. Use breathing respirator
  - 2. Thin finishing material to proper consistancy
  - 3. Practice adusting and manipulating
  - 4. If possible spray in a vertical position
  - 5. Strokes should run the length of the surface
  - 6. Strokes should overlap each other by about 2"
  - 7. Remove runs immediately by wiping

    8. Several thin coats is better than one thick coat
- G. Gun cleaning
    1. Clean immediately after use
    2. Gun canister empted
    3. Spray solvent through
    4. Take gun nozzle apart for cleaning

- H. Brush cleaning
    1. Wipe on edge of container
    2. Remove excess material on newspaper etc
    3. Rinse brush in suitable solvent
    4. Hold handle down to clean heal
    5. Wash with liquid detergent and rinse
    6. Squeeze water out and reshape
- I. Epoxy coatings
    1. Applications
        - a. Nautical - salt water
        - b. Nuclear Energy Industry
    2. Procedure
        - a. Mixing resins, hardeners
        - b. Spraying
        - c. Brushing
        - d. Drying
    3. Cost
- J. Electro chemical finishing
    1. Electro plating
        - a. Procedure
            1. Current
            2. Anode
            3. Cathode
            4. Electrolyte
        - b. Metals used
            1. Copper
            2. Nickel
            3. Chromium
            4. Tin
            5. Zinc
            6. Brass
            7. Gold
            8. Silver
    2. Anodizing
        1. Alluminum
        2. Magnesium

XIII. Machine Shop Orientation

- A. General safety practices reviewed
    1. Protective clothing and equipment
    2. Holding work pieces
    3. Mechanical hazards
    4. Non mechanical hazards
    5. Oil and water on floors
    6. Clean up of work area

B. Equipment and layout
   1. Horizonatl band saw
   2. Vertical band saw
   3. Hand feed drill press
   4. Metal lathe
   5. Milling machine

C. Sequence of operations
   1. Premachining of piece parts
   2. Premachining of sub assemblies
   3. Final machining for plate weldments
      a. All welding completed
      b. All heat treating complete
      c. All straightening and fairing complete
      d. Premachining, heat treating operations completed
      e. Finishing and coating usually complete

XIV. Metalworking lathes

A. Principle
   1. Single point cutting tool
   2. Revolving work piece
B. Kinds
   1. Manually operated
   2. Hand screw machine
   3. Turret lath
   4. Numerically controlled turret lath
C. Size
   1. Largest diameter of work that can be turned
   2. Distance between centers
D. Components
   1. Bed
   2. Headstock
   3. Tail stock
   4. Spindles
   5. Tailstock hand wheel
   6. Lath centers
   7. Carriage
E. Head stock drive systems
   1. Flat belt
   2. Back gear systems
   3. V-belt drive
F. Carriage feed
   1. Longitudinal
   2. Cross
   3. Feed rate
G. Lathe accessories
   1. Spindle noses
   2. Lathe chuck
      a. Types
      b. Care
      c. Installing & removal
      d. Centering work pieces
         (1) without mechanical aids
         (2) with dial indicator
         (3) with wiggler

- H. Lathe cutting tools
  - 1. Materials
  - 2. Shapes
- I. Tool Holders
- J. Cutting speed

- K. Feed selection
  - 1. Feed rate
  - 2. Depth of cut
- L. Types of cutting tools
  - 1. Turning
  - 2. Facing
  - 3. Radius
  - 4. Cutoff
  - 5. Threading
- M. Drilling Procedure
- N. Straight turning
- O. Facing
- P. Boring
- Q. Taper turning
  - 1. Compound rest
  - 2. Tailstock offset
  - 3. Cutting Threads

XV. Milling Machine operations

- A. Milling Machine principles
  - 1. Multiple Teeth revolving cutting tool (milling cutter)
  - 2. Work piece mounted on milling machine
    Table - feed against revolving milling cutter
- B. Types
  - 1. Horizontal milling machine
    - a. Bed type
    - b. Column and knee
  - 2. Vertiacal milling machine
    - a. Bed type
    - b. Column and knee type
- C. Milling machine controls
  - 1. Knee elevation
  - 2. Transverse table movement
  - 3. Longitudinal movement
  - 4. Spindle speed adjustment
  - 5. Feed adjustment
- D. Direction of feed
  - 1. Up (conventional milling)
  - 2. Down (climb) milling
- E. Safety for milling
  - 1. Wear safety glasses
  - 2. Wipe up oil on floor around machine
  - 3. Keep table clean and dry
  - 4. Tightly secure work holding devises
  - 5. Select the right kind of cutter
  - 6. Clean arbor, cutter and collars before mounting in spindle
  - 7. Use lead hammer to seat work piece securely in vise
  - 8. Make certain vise and holding devises clear arbor and overarm supports
  - 9. Select proper cutting speed, RPM and rate of feed

10. Disengage control handles when using automatic feeds
11. Make certain column clamps, saddle clamps are table clamps and loosened when making set up adjustment
12. Keep hands away from revolving cutter at all times
13. Clear chips away from cutter with a brush
14. Release any automatic feeds after completing the job
15. Do not allow unauthorized persons within safety zone of the machine.
16. Clean & wipe machine, remove clips with scoop, never touch chips with fingers.

F. Work piece holding devices
   1. Vises
      a. Plain
         1. Mounted parallel
         2. Mounted at right angle
      b. Swivel
         1. Base turned to any angle
         2. Degree graduations on base
      c. Universal
         1. Base turned to any angle
         2. Jaws tilted to any angle
   2. Dividing head - dividing a number of equally spaced angular division.
   3. Universal spiral attachment - used to machine spiral surfaces on horizontal milling machine.
   4. Vertical milling attachment - perform vertical and angular milling operations on horizontal machines.
   5. Circular milling attachment - tables that can be swiveled in a horizontal plane.

G. Holding milling cutters
   1. Arbor shanks
      a. National milling machine taper
      b. 3 1/2" per foot
      c. Self - releasing
      d. Draw bar locking device
   2. Arbors
      a. Style A - single bearing, sleeve and pilot
      b. Syyle B - one or were bearing sleeves
      c. Style C - hold shell end mill arbors
   3. Adaptors
      a. Arbor adaptor - Faco mills to machine spindle
      b. Collet adapterr - mount taper spindle shank end mills
   4. Holders - hold straight shank end mills

H. Milling Cutters
   1. Plain milling cutters - cutting teeth only on outer periphery
   2. Side - milling cutters - cutting teeth on sides as well as periphery
      a. Plain
      b. Staggered tooth
      c. Half sided
   3. Metal - slitting saws
      a. Plain 1/32" to 3/16" width
      b. Staggered tooth - 3/16" and wider
      c. Screw slotting

4. Angular milling cutters
   a. Single angle
   b. Double angle
5. Contour cutters - curved surfaces
6. End milling cutters - slots, shoulders keyways pockets, curved edges.

I. Cutting speeds & feeds
   1. Factors affecting cutting speeds
      a. Kind of material
      b. Machineability rating
      c. Hardness
      d. Cutting tool material
      e. Cutting fluids
      f. Depth of cut, rate of feed
   2. Revolutions per minute - calculating RPM
      a. Inch formula
      b. Metric formula
   3. Feed rate - calculations

J. Procedure

XVI. Precision Grinding

A. Cylindrical
   1. Plain
   1. Universal

B. Internal grinding

C. Centerless grinding

D. Form grinding

E. Tool and cutter grinders

F. Surface grinding
   1. Types
      a. Horizontal & spindle
      b. Vertical spindle
   2. Size
   3. Holding work
      a. magnetic chuck
      b. machine vise
      c. clamp directly to table
      d. V blocks
   4. Operating features horizontal - spindle
      a. Grinding wheel elevation
      b. Wheel RPM
      c. Table read
      d. Depth of cut
         1. Rough v.s. finish
         2. Wet v.s. dry
         3. Machine and set up rigidness
      e. Grinding wheel selection
   5. Operating procedures - horizontal spindle
      1. Select correct grinding wheel with maximum RPM equal or higher than spindle RPM.
      2. Mount wheel on spindle.
      3. True wheel
      4. Remove all burrs & nicks from work piece.
      5. Mount work piece.
      6. Lubricate machine

7. Protect eyes with safety glasses
8. Move work piece under grinding wheel - table handwheel.
9. Lower grind wheel to touch work piece.
10. Move table for work piece to clear wheel.
11. Lower grinding wheel 0.002" to 0.003" for roughing cut. Lock head in position.
12. Feed tables longitudinally under grinding wheel at a steady rate.
13. Feed work piece crosswise and crossfeed turn for succeding cuts (0.100").
14. Continued until 0.030 to 0.50" remain for finish cut.
15. Make finish cut.
16. Shut off machine, remove piece, clean machinery and remove sharp burrs.

XVII. Auotomation and Numerical Control

A. Principles of automation
   1. Feed back control loop
      a. Open loop
      b. Closed loop
   2. Future of automation in Metal working
      a. Material handling
      b. Machine burning
      c. Machining

B. Numerical Control systems
   1. Principles
   2. Advantages
   3. Basis of N/C measurement
   4. Kinds of N/C
   5. Production steps in N/C operations

APPLIED LAYOUT TECH 2

COURSE SYLLABUS

1. SUMMARY STATEMENT

Metal Fabrication
Applied Layout Tech 2
457-225- 2 Credit hours

Office Location:
Telephone Number: (414) 743-2207

This course includes theory and hands on training in the use of geometry and trigometry, in table and fabrication layouts, template making, fixture design, pipe and pressure vessel layout, parallel line and radial line development, trangulation, nautical lofting, and sheet metal layout.

Synopsis Of Course:

A. Contents of the course:

This course is the 2nd of two semesters in the Metal Fabrication Program. The student will learn complex table layouts using geometry and trigonometry, fixture design, pipe and pressure vessel layout, parallel line, and radial line development, trangulation, nautical lofting, and sheet metal layout.

B. Methods to be employed:

Method used in this course is a combination of lecture and practical lab and field experiences. Use of the overhead projector, videos, slide/tape presentations and transparencies are used throughout the course in conjunction with metal fabrication lab.

C. Building Space and Equipment required:

Classroom space will be adjacent to fabrication lab. The fabrication lab will be used for layout lab work.

D. Personnel Needed:

Personnel required for course is one instructor for both classroom lectures and supervising the lab sessions.

II. Rationale For the Course

This course suceeds layout I which is a prerequisit. Course work parallels lecture and lab work performance in Metal Fabrication II. The course will direct students in techniques, procedure and production of layouts, templates, design, material requirements and cost estimating of work that is fabricated in the Metal Fabrication lab. Students will utilize math skills taught in Industrial Math I and II as well as subjects covered in Metal Fabrication I & II, as a primary background for work performed in Applied Layout II.

III. Course Objectives

1. The student will perform complex table and fabrication layouts using knowledge of geometry and trigonometry to establish accurate square and angular arcs and dimensions.

2. The student will design simple functional fixtures for use in set-up, welding and machining of appropriate metal fabrications.

3. The student will produce shell forming templates and perform shell and head layout for fittings of pipe and pressure vessel fabrications.

4. The student will master the use of parallel line development, trangulation and radial line development to produce patterns and templates for a full range of sheet metal and plate fabrication.

5. The student will learn nautical lofting terminology and procedures, compare to coventional plate layout and prepare nautical templates.

6. The student will prepare all patterns, templates, layouts and design fixtures necessary for processing and fabrication of complete weldmonts from complex detail and assembly prints.

IV. Classroom Policy

1. No eating, drinking in the classroom - no smoking anywhere in the school.

2. No horse play in the classroom or inside and outside the labs.

3. No student will be allowed to work in the labs who is under the influence of alcohol or other drugs.

4. Any disruptive behavior is grounds for removal from the class.

5. All safety rules will be emphasized and followed throughtout the course.

V. Attendance Policy

Due to the nature and structure of this course, class attendance is of the upmost importance to the successful completion of this course. Attendance will be recorded daily and will become a part of your permanent record. If the student's progress is being hampored due to absences, a referral shall be made to the appropr Student services counselor.

VI. Grading Scale

The following grading scale will be used to numerically determine the student's grade for the course:

A = 93 - 100
B = 85 = 92
C = 77 - 84
D = 70 - 76
F = 0 - 69 (Failing)

Computing Grades

Grades will be figured by adding test points, lab points, and quiz points together and dividing the total possible. The percentage will fall within the scale above.

Total grade determined by the following:

Major Test -)Points will be given for attendance
Quizzes -)and each category listed on left
Lab & Field -)The total number of points will
make up 90% of the final grade.
Participation -)10%

Major Tests:

These tests may be made up within 10 school days, but they may not be the same tests.

Quizzes:

Quizzes must be made up within (5) school days or they will be recorded as a zero.

STUDENTS ARE RESPONSIBLE TO MAKE UP TESTS

Labs & Field Work:

Labs are considered as the major part of the class and all students are expected to participate. Labs will not be completed untill all material, tools and equipment has been stored properly and work area cleaned up. Students will not be allowed to leave until formally dismissed by the instructor. An early leave counts as an absence for the day. Students will be graded on initiative, communications, cooperativeness, crew integrity and positive attitude.

Text Required:

1. Metal Fabrication A Practical Guide
2. Metalwork Technology and Practice

Student Material List

1. Tool Box
2. Loose leaf note books & Paper (3ring holder)
3. Pens and pencils
4. Hard toe safety shoes
5. Hard hat
6. Safety glasses w/side shields
7. Gloves
8. Work clothing
9. Combination square
10. Steel punch
11. 12' Steel tape
12. Ball peen hammer
13. Scientific calculator

Job Opportunities

1. Sheet Metal industries
2. Structural steel construction and products
3. Plate Fabricators Products
   a. Construction equipment
   b. Military equipment
   c. Handling equipment
   d. Manfucturing equipment
4. Metal Fabrication Job shops
5. Pipe Fabrication
6. Pressure Vessel Fabrication
7. Ship building industry

Best Students Get The Best Jobs

No guarantee of a job when you graduate
Depends on you
We cannot get you the job

Willingness To Re-locatd For a Job

Don't limit yourself to this area

NWTC - Employment Assistance Center

Main Objectives:

To obtain marketable skills so that you can get a job. You will get out what you put into the class.

COURSE NUMBER 457-225-
COURSE TITLE Applied Layout Tech 2I

STUDENT TEXTS:

Title:	Metal Fabrication A Practical Guide
Authors:	Robert L O'Con, Richard H. Carr
Publisher:	Prentice-Hall Inc., Englewood Cliffs NJ 07632

Date Adopted: 1991 Copyright Date 1985

Title:	Metalwork Technology and Practice
Authors:	Victor E Repp, Willard J. McCarthy
Publisher:	Glencoe Publishing Company

Date Adopted 1991 Copyright Date 1989
Edition 8th

References:
Weldment Distoration - AWS
Pacific Press and Shape Comparr/Corporation and Maintainence Manual
Practical Sheet Metal Layout
Metals Hand Book - Vol 1-10

"A Treatise on Geometric Dimensioning and Tolerancing" by Lowell W Fister, Honeywell Inc.

Visual Aids:
Transparencies taken from above references
Various related videos and slide/tape presentations

Special Equipment and Supplies:
Overhead transparency
Slide projector W/tape
Television and VCR
Screen

SYLLABUS FOR: Layout 2

TEXT: Metal Fabrication
Metal Work

DATES — SESSION — TOPICS & BEFORE-CLASS ASSIGNMENTS

Scheduled — Actual — CLASS SESSIONS:

Week #1 & 2

________ ______ Table layouts

Assignments:
- Square layouts
- Angular layouts
- 3rd dimensional layouts

Week #3

________ ______ Fixtures

Assignments:
- Fixture Design

Week #4 - 5

________ ______ Pressure Vessel Layout

Assignment:
- Shell forming templates
- Shell and head layout for fittings

Week #6 - 7

________ ______ Parallel Line Development
Radial Line development
Layout by Trangulation

Read:
- "Metal Work" pp 251-256

Assignment:
- Layout of ells
- Layout of cones and pyramids
- Layout of square to round transitions

-------- ------ **Week #8**

Nautical Lofting
Shipyard Tour

-------- ------ **Week #9**

Nautical Lofting
Mid Semester Exam

-------- ------ **Week #10, 11, 12, 13, 14, 15, 16, 17**

Individual Fabrication layout projects
Templates
Material requirements
Processing methods
Fabrication methods
Fixture design

-------- ------ **Week #18**

Individual Layout Projects
Final Exam

I. Table Layout

- A. Purposes
    1. Establish squareness
    2. Perppendicularly
    3. Angularity
    4. Flatness
    5. Straightness
    6. Parallelism
    7. Roundness
    8. Profile
    9. Position
    10. Dimensional size
- B. Applications
    1. To check and hold shape & form of individual piece parts.
        - a. Structural shapes
        - b. Rolled and formed parts
        - c. Flatness
        - d. Straightness
    2. To check and hold linear dimensions of piece parts
        - a. Length
        - b. Width
        - c. Height
        - d. Coped ends
        - e. Arcs and radii
    3. Location & position of piece parts on fabrications
        - a. Location directly off table layout
        - b. Transfer layout from table to member parts
            1. Levels
            2. Squares
            3. Plumbs
            4. Straight edges
            5. Chalk lines
            6. Patterns, templates
- C. Establishing square layouts
    1. Check squarness of table top
        - a. Make sure longitudinal dimensions are the same both ends.
        - b. Make sure width dimensions are the same both ends.
        - c. Make sure diagonal dimensions are equal.
    2. Use table edges and corners as square layout.
    3. Layout lines parallel to table edges and corner to establish square layout.
    4. Determine diagonal dimensions
        - a. Length dimensions (A)
        - b. Width dimension (B)
        - c. Diagonal dimension (C)
        - d. Pythogorian Therom (C2=A2+b2)
- D. Establishing angular layouts
    1. 60 degree, 30, 20, 15 degree, 7 1/2 degree angles
        - a. Define equalatoral trangle
            - (1) Equal length of sides
            - (2) 60 degree equal angles

b. Layout equalatoral trangles
c. Section triangle legs
(1) Half section - 30 degrees
(2) 1/3 Section 20 degrees
(3) 1/4 Section 15 degrees
(4) 1/8 Section 7 1/2 degrees
2. 90 degree, 45 degree, 22 1/2 degree angles
a. Define right angle trangle
(1) Degrees of angle oposite hypotenuse
(2) Adjacent legs can very
b. Layout right angle triangle
(1) Use trammel points to establish origin and arc approx 120 degree
(2) Layout one leg of angle from origin to arc
(3) Calculate hypotenuse of triangle A2+A2=C2
(4) Set tramel points to dimension and arc
(5) Layout adjacent leg and hypotenuse
(6) Section hypotenuse
(a) Half section 45 degree
(b) 1/3 section 30 degree
(c) 1/4 section 22 1/2 degree
(7) 3, 4, 5, rule
(a) Layout with trammel point to establish 90 degree angle
(b) Layout 2 and 3 section hypotenuse to find 45 degree, 30 degree, 22 1/2 degree
3. Angular dimensioning natural trigon metric functions
a. Using trigonometric data charts
(1) sine
(2) cosine
(3) tangent
b. Layout with trigonometric data
4. Linear dimensioning from drawing dimensions
5. Production of angular patterns
a. Wood
b. Sheet Metal
E. Transfer of dimensional table layout to 3rd dimensional work piece layout.
1. Perpendicular layout
(a) Tools
(b) Marking procedure
(c) Checking dimensional accuracy
2. Angular layout transfer
(a) tools
(b) checking dimensional accuracy
3. Interior hole and shape location
(a) Tools
(b) Checking for dimensional accuracy

II. Fixture Design

A. Purpose
1. Locate and hold work pieces in a dimensional layout
2. Locate and hold piece parts in 3rd dimensional layout
3. Save time from individual table layouts.
B. Procedures
1. Determine dimension reference points from blueprint.
2. Location of drilled holes

  - a. From pre-drilled hole centers
    - 1. Use pins to locate piece parts with pre-drilled holes
    - 2. Clips on stops to establish accrate linear
  - b. Locating hole centers for drilling
    - 1. Clips or stops to locate piece parts
    - 2. Plate with hole diameter to accommodate tight fit of hand punch hole center
  - c. Drill fixtures using drill bushings
- 3. Critical interior dimensions
  - a. Use spacers to locate piece parts from interior
  - b. Separate spacer or can be fixed to fixture if no interference for fabrication removal from fixture.
- 4. Allignment of piece parts
  - a. Holes use pins
  - b. Exterior surfaces
    - 1. Dead stops on critical side
    - 2. Adjustable stops on oposite end to allow clearance for work pieces removal from fixtures
- 5. Construction
  - 1. Reinforced base plate
  - 2. Angle and gusset reinforced vertical location plates
  - 3. Clamping and holding devices
  - 4. Critical dimensions may require machining
    - a. Tolerance of fixture dimension must be much tighter than work piece tolerance
    - b. Make material allowances for required machining stock

III. Pressure Vessel layouts

- A. Layout for fabricated shells
  - 1. Seam rolled shells
    - a. Tangent to tangent dimension
    - b. Roll stock
    - c. Forming stock when ends are formed
    - d. Shell plate layout and marking
  - 2. 2 seam formed shells
    - a. Tangent to tangent dimensioning
    - b. Forming stock
    - c. Shell plate layout and marking
- B. Head layout for fittings
  - 1. Determine outside circumference
    - a. Variations in head diameter from print specification
    - b. Must measure each head with steel tape
    - c. Layout top and bottom @ 180 degree arc and punch mark
      - (1) 1/2 x circumference
      - (2) Check distance both directions
    - d. Layout all arcs for fittings locations in reference to top (x/360 degree x circumference
    - e. Locate center of head and punch mark
      - 1. 1/2 dia meter
      - 2. Check every 60 degree
    - f. Use chalk lines to layout centers for fittings from head center and punch mark.
    - g. Determine hole diameter required and joint preparation and mark for each fitting
- C. Layout of shell for fittings

1. Shell joints have been fabricated
2. Determine shell circumference
3. Determine shell top in proximity to shell joints and punch mark one end
4. Locate bottom @ 180 degree same end
5. Repeat location of top and bottom for oposite end
6. Use chalk line to mark layout of top & bottom from end to end.
7. Mark all longitudinal lengths for fittings on top or bottom layout line.
8. Determine distances around from top or bottom layout lines mark 2 places establishing parallel line.
9. Locate exact longitudinal location mark punch and label by hole size joint preparation and fitting.
10. Recheck all layouts

IV. Sheetmetal layout

1. Layout of 90 degree ells
   - a. 2 piece 45 degree seams
     - 1. Parallel line development reviewed
     - 2. Hem and seam allowance
   - b. 3 piece 22 1/2 degree seams
     - 1. Parallel line development
     - 2. Hem and seam allowance
2. Layout of 45 degree and 30 degree ells using parallel line development.
3. Fabrication of tees
   - a. 90 degree tees
   - b. 45 degree tees
   - c. 30 degree tees
4. Layout using radial line development
   - a. One piece pyramids
   - b. One piece cones
5. Layout using development by triangulation
   - a. Square to round transitions
   - b. Rectangular to round transitions

V. Nautical Layout

A. Nautical drawings
   1. Drawing views
      - a. Plan - top
      - b. Profile - front
      - c. Frame lines - sections
   2. Locational Forms
      - a. Length
        - 1. Frame lines
        - 2. Bulk heads
      - b. Height
        - 1. Water lines
        - 2. Decks
        - 3. Side views
      - c. Side views
        - 1. Port - left looking forward
        - 2. Starboard
      - d. Back
        - 1. Stearn

    - 2. After or aft
    - 3. Frames looking forward
  - e. Front
    - 1. Bow
    - 2. Forward
    - 3. Frames, looking aft
- B. Lofting technology
  - 1. Full scale drawing layouts
    - a. Plan - port side
      - 1. Decks
      - 2. Water Lines
    - b. Sectional views - port side looking forward
      - 1. Frames
      - 2. Bulk heads
    - c. Profile
      - 1. Port side
      - 2. By section between frame lines
  - 2. Frame templates
    - 1. Shape taken from full scale layouts of port side sectional views
    - 2. Port template as drawn
    - 3. Starboard - use port template opposite side
    - 4. Templates include all layouts for stiffeners and attachments
  - 3. Shell plate templates
    - 1. Developed shape by trangulation
      - a. Plan - vertical seams between frame lines
        - 1. Use seams approximately 3 frames wide
      - b. Sectional views
        - 1. Forward, aft development
        - 2. Forming templates
      - c. Profile
        - 1. Vertical development
        - 2. Forming templates
      - d. Template marking
        - 1. Port shells as drawn
        - 2. Starboard - opposite side
        - 3. Tangent lines for shape templates
          - a. Vertical
          - b. Horizontal
  - 4. Forming templates
    - a. Identifying tangent line
    - b. Separate template for each tangent line
    - c. Same template used for both port and starboard

COURSE NO. 457-225-

MODULE/UNIT NO. 1

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

TERMINAL COMPETENCY: Know the purposes and applications of table layouts, use table edges, triangular layout and trigonometric functions to establish square and angular layouts and transfer 3rd dimensional layout to work pieces.

LECTURE TIME 2

LABORATORY TIME 6

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain the purposes and applications of table layouts.	Lecture and discussion	Verbal quizzing
2. Explain and demonstrate methods to establish squareness of table layouts.	Demonstrations of square table layout techniques.	Mid semester exam
3. Explain and demonstrate methods to establish accurate angular layouts. a. Equilatarel triangles. b. Right angle triangles. c. Trigonometric functions. d. Drawing linear dimensions.	Demonstration of table angular layout techniques. Assignment to perform square and angular table layouts and produce wood and sheetmetal angular patterns and project 3rd dimensional layout to work pieces.	Ability to use triangular layouts, table angles and trigonometric functions to make accurate square and angular layouts.

COURSE NO. 457-225

MODULE/UNIT NO. 2

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

TERMINAL COMPETENCY: Know the purpose and applications of fixtures and design, simple fabrication fixtures to accurately locate, hold and assemble fabrications to blueprint tolerance requirements.

LECTURE TIME 1

LABORATORY TIME 3

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain the purpose and applications of fixtures.	Lecture and discussion	Verbal quizzing
2. Describe and demonstrate considerations and procedures to design fabrication fixtures to accurately locate and hold work pieces to critical dimensions.	Demonstrate methods for designing fixtures to locate critical holes, interior and exterior work piece dimensions. Assignment to design simple fixtures from fabrication drawings.	Ability of students to design functional fixtures to accurately hold and locate fabrication assemblies.

COURSE NO. 457-225-

MODULE/UNIT NO. 3

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Wh itford

DATE

TERMINAL COMPETENCY: Perform layouts to roll and form 1 seam and multiple seam pressure vessel shells, and layout heads and shells to receive all fittings and attachments to print specifications.

LECTURE TIME 2

LABORATORY TIME 6

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate layout & marking procedures and forming on rolling stock consideration for single seam round shell fabrications. 2. Explain and demonstrate layout & marking procedure and forming rolling stock consideration for multiple seam round shell fabrications. 3. Explain and demonstrate pressure vessel head layout procedure. 4. Explain and demonstrate pressure vessel shell layout for all fittings and attachments.	Lecture and discussion Demonstration of pressure vessel shell plate layout, head and shell layout for fittings and attachments. Apply pressure vessel layout instruction to layout portion of fabrication lab pressure vessel fabrication assignments.	Verbal quizzing Mid semester exam Ability to perform accurate layouts on pressure vessel fabrication assignment.

COURSE NO. 457-115-

MODULE/UNIT NO. 4

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 2

LABORATORY TIME 6

TERMINAL COMPETENCY: Layout round ducts, square to round elbows, branches tees, funnels etc using parallel line & radial line development and trangulation.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Review parallel line deveopment and demonstrate layout of 90, 45 degree and 30 degree 2 and 3 piece ells with hem and seam allowances.	Read 251-255 Lecture and discussion	Verbal quizzing Mid semester exam
2. Explain radial line development and demonstrate layout of pyramids and cones using radial line development.	Demonstration parallel line, radial line and trangulation techniques.	Ability to use development techniques to accurately complete layout assignment.
3. Explain layout development by trangulation and demonstrate square and rectangular to round transition. Layout using trangulation.	Assignment to layout elbows, branches, tees and funnels, and pyramids using parallel line, radial line and trangulation development techniques.	

COURSE NO. 457-225

MODULE/UNIT NO. 5

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME 2

LABORATORY TIME 6

TERMINAL COMPETENCY: Interpret natuical drawing views and terminology. Compare to conventional plate fabrication drawings, and apply developing blueprint reading and template making skills to perform simular nautical lofting functions & templates.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Explain and demonstrate nautical drawing views and locational terms and compare convensional plate fabrication drawing views and terminology.	Lectures and discussion Shipyard Tour	Verbal quizzing Questions and enthusiasm during tour.
2. Explain and demonstrate nautical lofting technology. a. Full scale drawing layouts b. Frame templates c. Shell plate templates	Demonstration of nautical drawings explaining views and terminology. Demonstration of lofting technology Assignments to prepare scaled frame and shell plate templates.	Efficiency and accuracy in completing assigned template marking.

COURSE NO. 457-225-

MODULE/UNIT NO. 6

NWTC
INSTRUCTIONAL PLAN

INSTRUCTOR Carl Whitford

DATE

LECTURE TIME

LABORATORY TIME 36

TERMINAL COMPETENCY: Apply all aspects of layout training to determine material requirements, processing methods, fabrication methods and produce all templates and fixture designs to produce complet metal fabrications.

SPECIFIC OBJECTIVES	LEARNING ACTIVITIES AND RESOURCES	EVALUATION METHODS
1. Opportunity for students to apply layout training to determine material requirements, processing methods and fabrication methods of complex metal fabrications.	Individual layout projects Review, supervision and instructions from instructor.	Final exam project Student ability to determine effective methods of processing and fabrication.
2. Opportunity for students to apply layout skills to produce all templates and fixture designs required in the fabrication of complex weldments.		Accurate material requirements. Accuracy and completeness of templates.